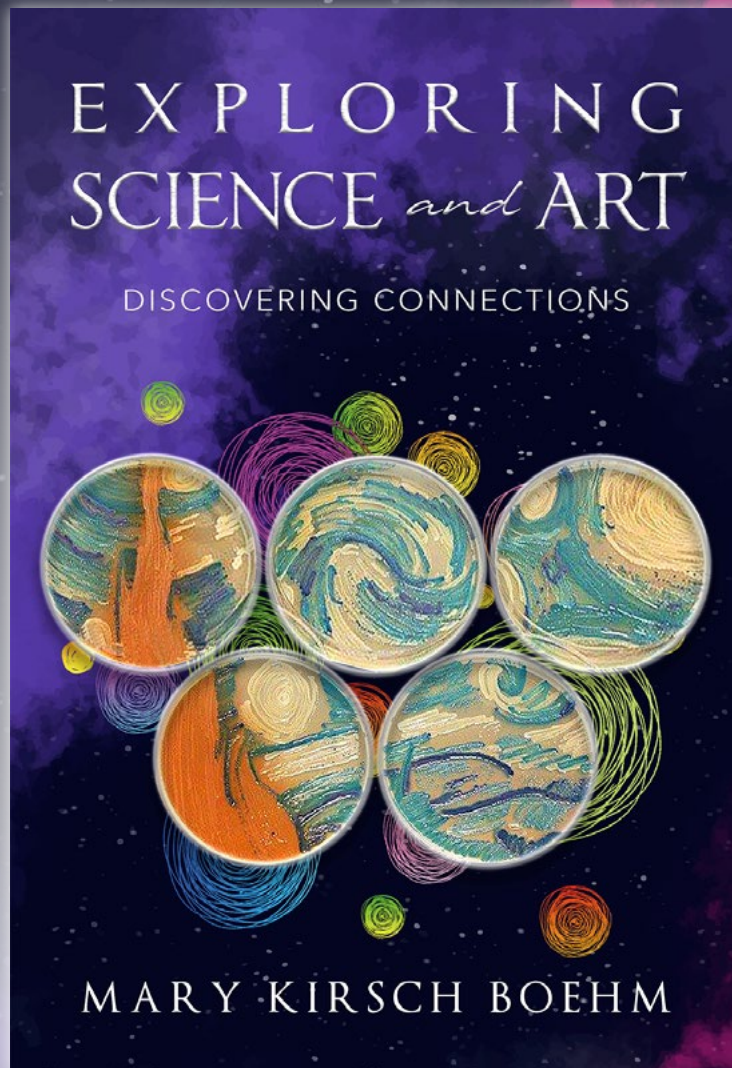


EXPLORING SCIENCE *and* ART



A Resource Guide

for

Science, Art, Art History, Interdisciplinary, and Humanities Courses
and
STEAM and Museum Programs

by

Mary Kirsch Boehm



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Contents

About <i>Exploring Science and Art</i>	3
A Brief Description of <i>Exploring Science and Art</i>	3
Using this Resource Guide	4
Table of Contents	5
Examples Included	10

About *Exploring Science and Art*

Exploring Science and Art is a venture of discovery. It introduces the idea that science and art are related, but the connections between them are often hidden and await discovery. It is intended for a general audience and will appeal to those in search of a fresh perspective, one with depth, dimension, and a degree of sophistication.

While not a text, *Exploring Science and Art* is filled with material that can be integrated into the science, art, art history, humanities and interdisciplinary courses offered by colleges, high schools and continuing education programs. The book can also be used with STEAM (science, technology, engineering, art, and math) and museum programs.

A Brief Description of *Exploring Science and Art*

Exploring Science and Art begins with *An Introduction*. Then *five main areas* are examined in search of relationships between science and art. (1) *About Science and Art* starts with the work of Einstein, Picasso, Leonardo, and others, and it includes a discussion of the nature of science, the nature of art, contemporary science and contemporary art. (2) *Materials and Techniques* investigates the materials and techniques of painting, sculpture, drawing, printmaking, glass, ceramics, and architecture, as well as the science behind them. (3) *Related Phenomena* reviews the science of light, color, vision, and illusion and the art related to them. (4) *Conservation* surveys the instruments and methods of science and their role in the preservation of art. (5) *Subject Matter* considers the human body, biodiversity, landscape, weather, and astronomy as both science and as an influence and inspiration for the creation of art. *Exploring Science and Art* ends with *In Conclusion*, where ten connections between science and art are proposed. The book also has *Notes* and an *Index*.

Within each of the five areas, the chapters are organized around unifying themes, and each chapter begins with an appropriate quotation. The chapters present the work of many scientists, artists, and others and are filled with examples and stories, some familiar and others less so. All relationships are developed and all connections are made with written descriptions. Illustrations, as such, are not included, but they are available online.

Using this Resource Guide

This *Resource Guide* includes a great deal of detailed information. Start with the *Table of Contents*. Read it to become familiar with the material included in each chapter. Then review the *Examples Included*.

How the material of *Exploring Science and Art* will be used depends upon the course, the students, and the teacher involved. Is it a science, art, art history, humanities, or interdisciplinary course? Or will it be used with a STEAM program or a museum exhibition? Are the students in college, high school, or continuing education? What are the teacher's preferences?

Illustrations of the *Examples Included* are available online. To locate images, search the internet using the name of the scientist or artist and the title of the work (sometimes dates and locations are also necessary).

Every chapter begins with a quotation. The quotations can be used as topics or starting points for discussions.

Ten Connections are proposed at the beginning of *In Conclusion*. They can also be used as topics or starting points for discussions.

Table of Contents

Exploring Science and Art: Discovering Connections

An Introduction

Exploring Science and Art is a venture of discovery. It enters the worlds of science and art to study science with an artistic eye and probe art with a scientific lens. As the chapters evolve, relationships are developed, connections are made, and an integrated and often overlooked view of science and art is introduced. References are made to a painting by van Gogh and a sculpture by Hodges.

About Science and Art

Chapter 1: Getting Started

The venture of discovery gets started with the science of Einstein, the art of Picasso and the versatile endeavors of Leonardo, and it includes the efforts of Carothers, Hubble, and Watson and Crick in science and those of Rembrandt, van Gogh, Close, Cezanne, and Monet in art. Their work is compared and relationships between them are discovered. Reference is made to *Picasso at the Lapin Agile*, a play by Martin.

Chapter 2: The Nature of Science

Science is explored and its basic nature is developed. Examples come from Aristotle and Galileo with falling objects, Banting and Best with insulin, Fleming with penicillin, Becquerel and the Curies with radioactivity, and Einstein with the equivalence of mass and energy.

Chapter 3: The Nature of Art

Art is explored and its basic nature is developed. Examples come from the art of Picasso, Pfaff, Michelangelo, Ai Weiwei, Viola, Ingres, Delacroix, Matisse, Munch, Reynolds, Manet, Pollock, Delaunay, Leonardo, Dali, Duchamp, Ringgold, Pfahl, DeCignis, Lin and the play, *Art*, by Reza.

Chapter 4: Contemporary Science / Contemporary Art

Contemporary science and contemporary art are today's science and art. Five areas of today's science (the fundamental nature of matter and energy, the expanding universe, the dynamics of the Earth's crust, the manipulation of life and human heredity) are reviewed, and the work of five contemporary artists (Mehretu, Price, Silverthorne, Barney and Kiefer) is reviewed. Reference is made to lyrics by Hammerstein.

Materials and Techniques

Chapter 5: The Science of Materials

The materials of science are the media of art. The physics and chemistry of materials and their properties are reviewed. References are made to sculptures by Puryear and Snelson and a painting by David.

Chapter 6: Paint and Painting

The materials and techniques of watercolor, gouache, encaustic, fresco, tempera, oil, and acrylic are explored, and the science behind them is discovered. Examples come from the art of Homer, Tissot, Giotto, Masaccio, Raphael, Michelangelo, Botticelli, Wyeth, Vermeer, Rembrandt, Frankenthaler, and Plimack Mangold.

Chapter 7: Sculpture

The materials of sculpture (stone, wood, metal, wax, clay and amber) and the techniques of carving, modeling, assembling, and casting are explored, and the science behind them is discovered. Examples come from the Amber Room, Oldenburg, Bourgeois, Morris, Michelangelo, Donatello, Giacometti, Degas, Caro, Nevelson, Rodin, Moore, and Ghiberti.

Chapter 8: Drawing and Printmaking

The materials and techniques of drawing and the printmaking techniques of relief, lithography, screen printing and intaglio (including etching and engraving) are explored, and the science behind them is discovered. The art of drawing and the art of printmaking are connected to science. Examples come from cave art, Dürer, Leonardo, Degas, LeWitt, Mangold, Ukiyo-e, Hogarth, Toulouse-Lautrec, and Warhol.

Chapter 9: Glass and Ceramics

Glass and ceramics are used to make art, and they have applications in science. The materials and techniques of glass and ceramics are explored, and the science behind them is discovered. Examples of glass art come from the Chartres Cathedral, Tiffany, Chagall, Roualt, BenTre, and Chihuly, and examples of ceramic art come from the Ishtar Gate, Greek pottery, Islamic lusterware, Southwestern pottery, della Robbia, the Prudential Guaranty Building, and mosaics.

Chapter 10: Architecture

Architecture involves the art of design, the use of materials and the science of construction, and the very nature of architecture is a combination of art and science. The scientific principles behind the design and building of the Ziggurat of Ur, the Great Pyramid, Greek temples, Incan structures, Roman arches, the Pantheon, the medieval cathedral, the Cathedral of Florence, the Leaning Tower of Pisa, the Eiffel Tower, the Sydney Opera House, the Hancock Center, the Hearst Tower, the Louvre Pyramid, the Gateway Arch, the MAXXI, and the National Museum of Qatar are discussed.

Related Phenomena

Chapter 11: Light and Color

Light and color are phenomena related to art. Science studies them to determine their nature, and art depends upon them. The science of Newton and Chevreul and the art of Knutsson, Jensen, Seurat, Delacroix, the Impressionists, Flavin, Arnleider, Krebs, and Holzer are discussed. Reference is made to a musical play by Sondheim and Lapine.

Chapter 12: Vision and Illusion

Vision and illusion are other phenomena related to art. Science studies them and art depends upon them. The eye, camera, photography, camera lucida, and camera obscura are reviewed, and illusions by mirrors, aerial and linear perspective, foreshortening, anamorphosis, and paint are discussed. Examples come from Stieglitz, Rogovin, Sherman, Fuss, the Hall of Mirrors, Samaras, Levi, Pistoletto, Kapoor, Leonardo, Caravaggio, Rembrandt, Holbein, Beever, Lippi, Vasarely, Poons, Genteschi, Masaccio, Hartnett, Plimack Mangold, Close, Davie, Soto, and Riley.

Conservation

Chapter 13: Into the lab

The instruments and methods of a modern laboratory are essential for scientific research, and they are the ways and means of art conservation. Imaging techniques, spectroscopy, carbon 14 dating, chromatography, and dendrochronology are described. Examples come from the art of van Eyck, Rembrandt, Rodin, Gentileschi, Leonardo, vanMeergen, and Tsegi Canyon.

Chapter 14: As Time Goes By

Conservation involves an understanding of the instruments, methods, and chemicals of science and the materials and techniques of art. The conservation of a 17th century painting, *P. Gabriel Barbisius*, is described in detail.

Chapter 15: To the Rescue

Conservation is a science *and* an art, and the two come together to preserve artistic heritage for future generations. They rescue art from the effects of aging, environment, human influence and natural disasters. The conservation of Picasso's *Les Femmes d'Alger*, the frescoes in the Sistine Chapel, the buildings on the Acropolis, the Lascaux cave, Greek bronzes, the city of Florence following its 1966 flood, the Egyptian pyramids and *The Last Supper* by Leonardo are described.

Subject Matter

Chapter 16: The Body Human

The human body and its condition provide substance for scientific study, and they influence and inspire the creation of art. Examples come from prehistoric art, Egypt, Xian, Greece, Rome, medieval times, Leonardo, Michelangelo, Vesalius, Rembrandt, Eakins, Roentgen, Mangano-Ovalle, Richardson's diagrams, Berry's animations, Henry Moore, Coplans, Mueck, Traini, Monteverde, Jenner, Pasteur, Koch, Stanley, Bleckner and the AIDS Memorial Quilt.

Chapter 17: Biodiversity

Life on Earth has great diversity—more than 1.7 million species exist. This diversity provides inspiration and serves as subject matter for art. Natural selection, classification and the work of Darwin and Linnaeus are reviewed. The art of the unicorn tapestries, Dürer, Heade, Audubon, Peterson, Bateman, and Moore is included.

Chapter 18: The Earth's Dynamic Landscape

The Earth's land forms and its rocks and minerals are studied by science, and they influence and inspire the creation of art. Examples come from the eruption of Mt. Vesuvius, Hokusai, Adams, O'Keeffe's New Mexico landscapes, and Graycliff by Wright. The geology of Niagara Falls is described in detail, and art inspired by the Falls is presented. Work by Benton, Cropsey, Bierstadt, Moran, Twachtman, Church, Grohe, Moore, and Cvijanovic is included.

Chapter 19: Weather, Whether or Not

Weather is studied by science, and the effects of weather influence and inspire the creation of art. Relationships between weather and art are examined using the art of Homer, Vermeer, Hare, Constable, Mitchell, Graves, Canaletto, Turner, Tissot, Monet, and Burchfield.

Chapter 20: The Sky Above

Astronomy is the oldest of the sciences, and it has inspired and influenced art for millennia. Relationships between astronomy and art are examined using the architecture of Stonehenge, Chichen Itza, and the great Pyramid. Also included is the work of Reinders, Libeskind, Ptolemy, Raphael, Copernicus, Kepler, Galileo, Brecht, Newton, Holbein, Church, Monet, Hopper, Whistler, the Limbourg Brothers, Bruegel, Thomson, Hartigan, Pissarro, Tyson, Giotto, Rauschenberg, and Graves are included. References are made to Brecht's plays based on Galileo.

In Conclusion

Exploring Science and Art is summarized. *Ten connections* between science and art are proposed. They are original, and perhaps surprising, statements that link science and art. Additional stories are included, and closing remarks are made.

Notes

Index

Examples Included in *Exploring Science and Art: Discovering Connections*

* specific example in text

Cover

* Sullivan, Melanie. Agar art inspired by van Gogh's *Starry Night* (1889), Museum of Modern Art

An Introduction

* van Gogh, Vincent. *Starry Night over the Rhône* (1888), Musée d'Orsay, Paris

* Hodges, Jim. *look and see* (2005), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY

1. Getting Started

* Martin, Steve. *Picasso at the Lapin Agile* (1993), an original play

* Picasso, Pablo. *Les Femmes d'Alger (O. J. R. M.)* (1907), Museum of Modern Art, New York

* Leonardo - paintings and drawings with hand-written notes

—Einstein, Albert - theories

—Hubble, Edwin - the expanding universe

—Carothers, Wallace Hume - polymers

—Watson and Crick - DNA molecular structure

—Rembrandt - self portraits

—van Gogh, Vincent - self portraits

—Close, Chuck - self portraits

—Cezanne, Paul - Mont Sainte Victoire paintings

—Monet, Claude - light and color, paintings of waterlilies

2. The Nature of Science

—Aristotle - early ideas

—Galileo - falling objects. the Leaning Tower of Pisa

—Banting and Best - discovery of insulin

—Fleming, Alexander - discovery of penicillin

—Becquerel and the Curies - discovery of radioactivity

—astronauts on the moon

3. The Nature of Art

* Reynolds, Joshua. *Cupid as a Link Boy* (1774), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY

* Pfaff, Judith. *Rock / Paper / Scissors* (1982), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY

* Munch, Edvard. *The Scream* (1893), The National Gallery, Oslo

- * Viola, Bill. *The Greeting* (1995), projected video
- * Goya, Francisco. *Third of May 1808* (1814 - 1815), The Prado, Madrid
- * Motherwell, Robert. *Spanish Elegy* series (1961)
- * Picasso, Pablo. *Guernica* (1937), Reina Sofia, Madrid
- * Manet, Edouard. *Le Dejeuner sur L'Herbe (Luncheon on the Grass)* (1863), D'Orsay, Paris
- * Leonardo. *Mona Lisa* (1503), The Louvre, Paris
- * Duchamp, Marcel. *Mona Lisa*, Mary Sisler Collection, New York, NY
- * Dali, Salvatore. *Mona Lisa*, Museum of Modern Art, New York, NY
- * Lin, Maya. Viet Nam Memorial, Washington, DC
- * Reza, Yasmina. *Art* (1994), an original play
- * Anderson, Hans Christian. *The Emperor's New Suit* (1837), a story
- * Albers, Joseph. *Homage to a Square* series
- Delaunay, Robert - art of its time and place
- Ringgold, Faith - cloth sculpture, art of its time and place
- DeCrisnis, Rudolf - reductive paintings
- Michelangelo - creativity
- Pollock, Jackson - drip paintings
- Ai Weiwei - provocative art
- Pfahl, John - computer-enhanced art
- Delacroix, Eugene - use of color in paintings
- Ingres, Jean Dominique - use of line in paintings
- Matisse, Henri - use of both color and line in paintings
- van Gogh, Vincent - paintings

4. Contemporary Science / Contemporary Art

- * Kiefer, Anselm. *Die Milchstrasse* (1985), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY
- * Hammerstein, Oscar. Lyrics for *It's a Puzzlement* from the musical, *The King and I* (1951)
- Big Bang Theory
- String Theory
- plate tectonics
- human heredity
- cloning
- Mehretu, Julie - paintings
- Silverthorne, Jeanne - art
- Barney, Matthew - films
- Price, Ken - sculptures

5. The Science of Materials

- * David, Jacques Louis. *Antoine-Laurent Lavoisier and His Wife* (1788), Metropolitan Museum,
- Puryear, Martin - art made of copper

- Snelson, Kenneth - art based on atoms
- atoms and molecules
- polymers
- inorganic and organic molecules

6. Paint and Painting

- * Botticelli, Sandro. *Birth of Venus* (circa 1482), Uffizi Gallery, Florence
- * Wyeth, Andrew. *Christina's World* (1948), Museum of Modern Art, New York
- * Giotto - frescoes from the Arena Chapel, Padua
- * Michelangelo Buonarroti. Sistine Chapel, Vatican City - frescoes
- Vermeer, Jan - oil paintings
- Rembrandt - oil paintings
- Homer, Winslow - watercolor paintings
- Burchfield, Charles - watercolor paintings
- Tissot, James - gouache paintings
- Johns, Jasper - encaustic paintings
- Masaccio. Santa Maria del Carmine, Florence - frescoes
- Raphael Sanzio. Stanza, Vatican City - frescoes
- Frankenthaler, Helen - acrylic paintings
- Plimack Mangold, Sylvia - faux tape and faux wooden floor paintings with acrylic paint
- Besemer, Linda - support free acrylic paintings
- mummy portrait paintings with encaustic paint

7. Sculpture

- * Crichton, Michael. *Jurassic Park* (1990), a novel and later a sci-fi film
- * Amber Room, Catherine Palace, St. Petersburg
- * Michelangelo. *David* (1501), The Academy, Florence
- * Donatello. *Mary Magdalene* (1454 - 1455), Duomo Museum, Florence
- * Degas, Edgar. *Little Dancer, Aged Fourteen* (1878 -1881), Mr. and Mrs. Paul Mellon Collection
Upperville, Virginia
- * Rodin, Auguste. *The Gates of Hell*
- * Rodin, Auguste. *The Thinker*
- * Ghiberti, Lorenzo. *Gates of Paradise* (1425-1452), Duomo Museum, Florence
- * Chartres Cathedral - sculptures
- Giacometti, Alberto - sculptures
- Caro, Anthony - sculptures
- Nevelson, Louise - sculptures
- Rodin, Auguste - sculptures
- Assyrian limestone and alabaster reliefs
- Mesoamerican reliefs
- Amarna Period - sculptures

8. Drawing and Printmaking

- * Lewitt, Sol. drawing (conceived 2006 / executed 2010), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY
- * Leonardo. *Virgin and Child with St. Anne and Infant St. John* (1499), National Gallery, London
- Degas, Edgar - pastel drawings
- prehistoric cave drawings
- Mangold, Robert - drawings
- Calame, Ingrid - drawings on mylar
- Dürer, Albrecht - prints, his signature logo
- Ukiyo-e - woodblock prints
- Hogarth, William - etchings
- Toulouse-Lautrec - posters
- Warhol, Andy - serigraphs

9. Glass and Ceramics

- * Babylon's Ishtar Gate. Pergamon Museum, Berlin
- * Sullivan and Adler. Guaranty / Prudential Building (1895-1896), Buffalo, NY
- Chagall, Marc - stained glass windows
- Tiffany, Louis Comfort - stained glass windows
- Rouault, Georges - stained glass windows
- Chihuly, Dale - glass sculptures
- Ben Tre, Howard - glass sculptures
- black figured and red figured Greek pottery
- Islamic lusterware
- Southwest pottery
- della Robbia - ceramic relief sculptures
- mosaics from Ravenna
- Chartes Cathedral - stained glass windows

10. Architecture

- * Bunshaft, Gordon. 1962 addition Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY
- * Ziggurat of Ur
- * Step pyramid at Saqqara, Egypt
- * Great Pyramid of Giza
- * Pantheon. Rome
- * Chartres Cathedral
- * Brunelleschi, Filippo. dome for Cathedral of Florence
- * Leaning Tower of Pisa
- * Eiffel, Alexandre Gustave. *La Tour Eiffel*, Paris

- * Hancock Center, Chicago, IL
- * Burchfield Penney Art Center, Buffalo NY
- * Pei, Ieoh Ming. Pyramid at the Louvre. Paris
- * Saarinen, Eero. Gateway Arch, St. Louis, MO
- * Hadid, Zaha. Rosenthal Center for Contemporary Art, Cincinnati, OH
- * Hadid, Zaha. National Museum of the XXI Century Art. "The MAXXI", Rome
- * Nouvel, Jean. National Museum, Qatar
- * Utson, Jørn. Opera House, Sydney
- * Gehry, Frank. Guggenheim Museum, Bilbao
- Greek temples
- Roman arches and key stones

11. Light and Color

- * Jensen, Alfred. *Solar Energy, Optics* (1975), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY
- * Monet, Claude. *Impression- Sunrise* (1872), Musée Marmottan, Paris
- * Chevreul, Michel Eugene. *On the Law of Simultaneous Contrast of Colors* (1839)
- * Seurat, George. *A Sunday Afternoon on the Island of La Grande Jatte* (1884-1886), Art Institute, Chicago, IL
- * Sondheim, Stephen and James Lapine. *Sunday in the Park with George* (1984), a musical play
- electromagnetic waves and electromagnetic spectrum
- primary colors of light and primary colors of paint
- Newton, Isaac - light and color studies
- Delacroix, Eugene - paintings
- Knutson, Anders - phosphor paintings
- Seurat, George - divisionist / pointilist paintings
- Flavin, Dan - fluorescent light sculptures
- Armleder, John - neon sculptures
- Krebs, Rockne - laser light art
- Holzer, Jenny - L.E.D. lighted pieces

12. Vision and Illusion

- * Samaras, Lucas. *Mirrored Room* (1966), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY
- * Le Brun, Charles. Hall of Mirrors, Versailles
- * Kapoor, Anish. *Cloud Gate* (2006), Millennium Park, Chicago, IL
- * Leonardo. *The Last Supper* (1495-1498), Santa Maria delle Grazie, Milan
- * Caravaggio. *Supper at Emmaus* (1596-1603), National Gallery, London
- * Rembrandt. *The Company of Frans Banning Cocq aka The Night Watch* (1642), Rijksmuseum, Amsterdam

- * Holbein, Hans. *The Ambassadors* (1533), National Gallery, London
- * Masaccio. *The Tribute Money* (1424), Santa Maria del Carmine, Florence
- * Masaccio. *The Holy Trinity* (1427), Santa Maria Novella, Florence
- * Lippi, Fra Filippo. *Madonna and Child with Angels* (circa 1455), Uffizi Gallery, Florence
- Parthenon columns
- Roman wall paintings
- Stieglitz, Alfred - photos of New York City
- Rogovan, Miton - photos of people in Buffalo, NY
- Sherman, Cindy - photos of herself dressed as other people
- Fuss, Adam - photograms
- Pistoletto, Michelangelo - art works
- Hartnett, William - *trompe l'oeil* paintings
- Beever, Julian - anamorphic sidewalk drawings
- Plimack Mangold, Sylvia - paintings with faux tape
- Close, Chuck - self portraits
- Davie, Karin - paintings with fluid loops
- Vasarely, Victor - paintings with optical properties
- Soto, Jesús Raphael - artwork using *moire*
- Poons, Larry - paintings with optical properties
- Riley, Bridget - paintings with undulating lines
- the human eye and the camera

13. Into the Lab

- * van Eyck, Jan. *Giovanni Arnolfini and His Bride* (1434), National Gallery, London
- * Rembrandt van Rijn. *Jacob Trip* (1661), The National Gallery, London
- * Rembrandt van Rijn. *Margaretha de Geer* (1661), The National Gallery, London
- * Rodin, Auguste. *The Thinker* (1880), The National Gallery, Washington DC
- * Gentileschi, Giovanni Lanfranco and Giovanni Lanfranco. *St. Cecilia and an Angel*, (early 17th century), National Gallery, Washington, DC
- * Leonardo. *Adoration of the Magi*, Uffizi Gallery, Florence
- spectroscopes and spectra
- x-ray, infrared and ultraviolet
- carbon 14 and dendrochronology

14. As Time Goes By

- * *P. Gabriel Barbisius* (17th century) private collection
- Conservation Laboratory at Buffalo State College, Buffalo, NY

15. To the Rescue

- * Picasso, Pablo. *Les Femmes d'Alger (O. J. R. M.)* (1907), Museum of Modern Art, New York
- * Michelangelo. *Sistine Ceiling* (1508-1512), Sistine Chapel, Vatican City

- * Michelangelo. *Last Judgment* (1535-1541), Sistine Chapel, Vatican City
- * *Elgin marbles*, British Museum, London
- * *Riace bronzes*, Reggio Calabria, Italy
- * Leonardo. *Last Supper* (1495-1498), Santa Maria delle Grazie, Milan
- * Montorfano, Donato. *Crucifixion* (1495), Santa Maria delle Grazie, Milan
- Lascaux caves
- Florence flood of 1966

16. The Body Human

- * Mangano-Ovalle, Iñigo. *The Garden of Delights* (1998), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY
- * *Queen Nefertiti*, Neues Museum, Berlin
- * *Terra cotta warriors*, Qin Shi Huangdi tomb, Xian, China
- * Avicenna of Persia. *Canon of Medicine*
- * Vesalius, Andreas. *De Humani Corporis Fabrica Libri Septem* aka *Fabrica*
- * Grünewald, Mathias. *The Isenheim Altarpiece* (1512-1516), Unterlinden Museum, Colmar, France
- * Rembrandt van Rijn. *The Anatomy Lesson of Dr. Tulp* (1652), Mauritshuis, The Hague
- * Hood, Walter. *The Solar Strand* (2012), State University of New York at Buffalo, NY
- * Rupp, Christy. *The Landscape Within* (1999), Castellani Museum, Niagara University, Niagara Falls, NY
- * Eakins, Thomas. *Gross Clinic* (1875), The Philadelphia Museum of Art and the Pennsylvania Academy of Fine Arts
- * Bosch, Hieronymus. *The Garden of Earthly Delights* (circa 1500), The Prado, Madrid
- * Mueck, Ron. *Untitled (Big Man)* (2002), Hirshhorn Museum, Washington, DC
- * Traini. *The Triumph of Death*, Camposanto, Pisa
- * *AIDS Memorial Quilt*
- Holbein, Hans - *The Dance of Death* wood cut prints
- King Akhenaten - sculptures
- Moore, Henry - *Reclining Figures*
- Coplans, John - self portrait photographs
- Bleckner, Ross. *In Replication* series
- dissection theatres
- Vesalius - anatomy drawings
- prehistoric cave drawings of people
- AIDS Memorial Quilt*

17. Biodiversity

- * Dürer, Albrecht. *The Great Piece of Turf* (1503), Albertina, Vienna
- * *Unicorn Tapestries*, The Cloisters, New York
- * Audubon, John James. *The Birds of America*
- * Moore, Frank, *Resistant Fauna*, 1994, private collection
- * Bateman, Robert - *Wildlife Images*

* Darwin, Charles. *On the Origin of the Species by Means of Natural Selection* (1859)

* Tam Van Tran - *Spirulina* paintings

* Heade, Martin Johnson - paintings of the South American rain forest

* Peterson, Roger Tory. *A Field Guide to the Birds* (1934)

— *The Dance of Death* wood cut series

—Linnaeus, Carolus - biological names

—natural selection and evolution of species

—plant and animal classification

18. The Earth's Dynamic Landscape

* Moore, Frank. *Niagara* (1994-1995), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY

* Wright, Frank Lloyd. Graycliff Estate on Lake Erie, Angola, NY

* van Vienen Jan. *View of Niagara Falls* (late 1600s)

* Benton, Thomas Hart. *Father Hennepin at Niagara Falls* (1961), Niagara Power Project Visitors Center, Lewiston, NY

* Grohe, Eric. *Niagara Falls* (1997), Shopping Mall of Niagara Falls, Niagara Falls, NY

* Cvijanovic, Adam. *Niagara* (2006), installation at the Center for Arts UB Art Gallery, Center for the Arts, North Campus, State University at Buffalo, Amherst, NY, 23 March-29 July 2006

* Hokusai, Katsushika. *Thirty-Six Views of Mt. Fuji*

* O'Keeffe, Georgia. *Cliff Beyond Abiquiu—Dry Waterfall* (1943), Cleveland Museum of Art, Cleveland, OH

—geological time scale

—Earth's formation

—tectonic plates

—folded and block fault mountains

—volcanoes

—weathering and erosion

—Pompeii and Herculaneum

19. Weather, Whether or Not

* Hare, David. *Sunrise* (1954-1955), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY

* Inness, George. *The Coming Storm* (1878), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY

* Mitchell, Joan. *George Went Swimming at Barnes Hole, But It Got Too Cold* (1957), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY

* Burchfield, Charles. *December Storm* (1941-1960), Burchfield Penney Art Center, Buffalo, NY

* Homer, Winslow. *Breezing Up* (1876), National Gallery, Washington, DC

* Vermeer, Jan. *View of Delft* (1660-1661), Mauritshuis, The Hague

* Constable, John. *Study of Cirrus Clouds* (circa 1822), Victoria and Albert Museum, London

* Graves, Nancy. *Hurricane Camille* (1973), Jamie C. Lee collection

- * Turner, J.M.W. *The Decline of the Carthaginian Empire* (1817), The Tate Britain, London
- Canaletto - paintings of Venice and its canals
- Monet - London paintings
- weather and climate
- climate change
- cloud types
- weather fronts
- storms, tornadoes, and hurricanes

20. The Sky Above

- * Hartigan, Grace. *New England, October* (1957), Buffalo AKG Art Museum (formerly Albright-Knox Art Gallery), Buffalo, NY
- * Raphael. *School of Athens* (1509-1511), Stanza, Vatican Museum, Vatican City, Rome
- * Holbein, Hans. *The Ambassadors* (1533), National Gallery, London
- * *Stonehenge*, near Amsbury, England
- * Reinders, Jim. *Carhenge* (1987), Alliance, NE
- * *El Caracol* and *El Castillo* at Chichén Itzá, Mexico
- * Libeskind, David. Original plan for the rebuilding of the World Trade Center
- * Church, Frederich. *Twilight in the Wilderness* (1860), The Cleveland Museum of Art, Cleveland, OH
- * Hopper, Edward. *Early Sunday Morning* (1930), Whitney Museum of American Art, New York, NY
- * Hopper, Edward. *High Noon* (1949), The Dayton Art Institute, Dayton, OH
- * Hopper, Edward. *Morning Sun* (1952), Columbus Museum of Art, Columbus, OH
- * Whistler, James McNeil. *Nocturne in Black and Gold: The Falling Rocket* (1875), Detroit Institute of Arts, Detroit, MI
- * Limbourg Brothers. *Les Tres Riches Heures* (1413-1416), Musée Condé, Chantilly
- * Bruegel, Pieter the Elder. *The Dark Day* (1565), Kunsthistorisches Museum, Vienna
- * Bruegel, Pieter the Elder. *The Hay Harvest* (1565), National Gallery, Prague
- * Bruegel, Pieter the Elder. *Harvesters* (1565), The Metropolitan Museum of Art, New York
- * Thomson, Tom. *The Pool* (1917), National Gallery of Canada, Ottawa
- * Bayeux tapestry panel # 67 showing comet, Bayeux Cathedral Museum, France
- * Rauschenberg, Robert. *Stoned Moon* series
- * Giotto. *Adoration of the Magi*, (1304-1306), Arena Chapel, Padua
- * Grünewald painting, *The Isenheim Altarpiece* (1510-1515), Musée d'Unterlinden, Colmar, France
- * Galileo. *Dialogue on the Two Chief World Systems* (1632)
- * Brecht, Bertold. *The Life of Galileo* and *Galileo*
- * Newton, Isaac. *Principia Mathematica* (1687)
- Monet - paintings of hayracks
- Pissarro - paintings of winter scenes
- geocentric and heliocentric theories

In Conclusion

* Sullivan, Melanie. Agar art based on *Starry Night* (1889) by Vincent van Gogh, Museum of Modern Art, New York

—Pollock drip paintings

—chimeras

—DNA profiles

—chiasmata

—Kiasma Museum, Helsinki