HOW STUFF WORKS
TEACHER RESOURCE

THE NEWARK MUSEUM OF ART

newarkmuseumart.org

WELCOME TO THE NEWARK MUSEUM OF ART!

Dear Teachers,

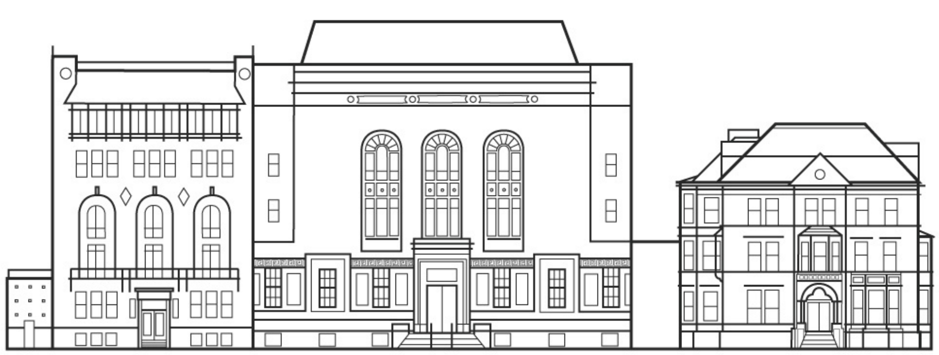
We are happy to present *How Stuff Works* Teacher Resource. The goal of our school and teacher programs is to provide students an opportunity to connect museum objects with their own lives and understand how these objects connect to subject matter they are learning in their classrooms.

This teacher guide is based on our collection and provides a framework for you and your students. The discussions and activities introduce some key themes and concepts for classroom reflection and lessons.

We look forward to the conversations sparked among your students.

Thank you for choosing The Newark Museum of Art!

NMOA School Programs Team



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HOW STUFF WORKS

"Habit is a powerful means of advancement, and the habit of eternal vigilance and diligence, rarely fails to bring a substantial reward."

—Lewis Latimer, inventor

How Stuff Works explores art's role in documenting history through the artist's experiences and exploring how scientific advances have impacted society.

Throughout history, scientific advances have positively and powerfully influenced our civilization—such as the development of electric power for the masses and suspension bridges that could span large bodies of water, bringing the world a little closer. These advances were challenges the result of trial and error, creativity and persistence, on the part of inventors and engineers who did not regard failure as an end but as an experience that would contribute to a breakthrough.

Students will be encouraged to thoughtfully observe artwork, recognize the time period it is depicting, and explore how the development of new technologies has impacted society, past and present. Students will have the opportunity to create the technology through hands-on experiments to learn how it works and gain an appreciation of the inventor's thought process.

PRE-VISIT
SPARK A CONVERSATION

Before getting into the meat of the lesson, we recommend that you and your students explore and discuss the themes of the resource. We have included some selected images from the collection, along with relevant information. You can print out the images or project them in your classroom.

Pre-visit Objectives:

- Introduce students to the artists and works in the collection
- Examine themes and topics students may encounter
- Explore how artists interpret their surroundings and how it manifests in their work

1. Art as a Historical Record

   The chosen works feature artists who used materials, techniques, approaches, and subject matter to depict how the development of new technology impacted their lives. Art is not a strictly fact-based historical record—it delves deeper by conveying how it felt to exist in a particular time and place. It allows us to look back on and understand through the artist’s lens how our society has developed. Foster a discussion with your students about art as a historical record. Do they agree that art is in fact a historical record? Which is more accurate, a fact-driven record from a history textbook or experience-driven artworks? How does viewing an artist’s interpretation of their experience enhance the observer’s knowledge about the past? Have students add their thoughts to a word cloud and ask them to save their answers for further discussion after they view the works in the collection (see Post-Visit Reflection).

2. How Technology Impacts Society and Culture

   Spark a discussion with students on how the advent of new technology influences everyday life and culture. Ask students to imagine life without electric light or bridges that connect cites, or society’s future without the development of renewable energy. How has it advanced the lives of those at different socioeconomic levels? How has it transformed our culture? Have students add their thoughts into a word cloud and ask them to save their answers for further discussion after they view the works in the collection (see Post-Visit Reflection).

THE NEW EXPERIENCE: ELECTRIC LIGHT

JOHN SLOAN

PICTURE SHOP WINDOW

John Sloan, ***Picture Shop Window***, 1907
Oil on canvas, 32 in. x 26 in. (99.7 x 83.1 cm)
Gift of Mrs. Felix Fuld, 1925 *25.1163*

John Sloan was a member of the Ashcan School of Art movement, a loosely linked group of artists who lived primarily in the New York City area in the early 1900s. The Ashcan School created art that depicted the gritty reality of urban working-class Americans and immigrants, as opposed to glamorized ideals, and believed in the worthiness of the working class as a subject for art.

Sloan's paintings utilized a dark palette and gestural brushwork that helped shape this new genre of realism. The subject matter conveyed a sense of haste and the liveliness of working people in "modern" New York City: people walking in parks and enjoying public spaces illuminated by the recent advancement of artificial lights.

Discussion:
Foster a student discussion about Sloan's painting.

Suggested questions to start the discussion:

- Would it be exciting to have electric light for the first time as an adult?
- How do you think it impacted their lives?
- How do you think your lives would be if electric light had never been invented?

https://www.theartstory.org/movement/ashcan-school/

CONNECTING US: BRIDGES

JOSEPH STELLA

THE VOICE OF THE CITY OF NEW YORK INTERPRETED

Joseph Stella, ***The Voice of the City of New York Interpreted,*** 1920-1922
Oil and tempera on canvas, 99.75 x 270 in. (253.4 × 685.8 cm)
Purchase 1937 Felix Fuld Bequest Fund *37.288A-E*

Joseph Stella was an Italian-born American Futurist painter known for his depictions of industrial America and for his painting of the Brooklyn Bridge. Futurism was an Italian art movement of the early 20th century that aimed to capture the dynamism and energy of the modern world. Stella grew up outside of Naples, Italy, and through his art he shared his experience of encountering the modernity of New York City. His art is a celebration of industry and of what humankind has created.

This piece comprises five panels that depict from left to right: *The Port*, where goods are brought into the city; *The White Way*, the lights of Broadway; *Skyscrapers*; The White Way, Broadway again; and finally, *Brooklyn Bridge*.

Stella was not interested in creating a photographic likeness, but he wanted to share the city as he say it. His view of the Brooklyn Bridge is one of awe of the modern engineering feat of steel and concrete, and imparts the importance of technology in our culture. He pulls the viewer in and gives a feeling of levitation, as if their feet have left the ground. He uses the bridge cables to sweep viewers eyes up to the bridge's gothic arches which are reminiscent of a church.

Discussion:

Foster a student-led discussion about Stella's painting:

- Would it be exciting to live during a time of great engineering advances such as the earliest built bridges and skyscrapers?
- How did Stella share his excitement?
- How different would New York City be if bridges did not exist to connect the metropolitan area?

https://smarthistory.org/joseph-stella-new-york-interpreted/

RENEWABLE ENERGY: WINDMILLS

UNIDENTIFIED ARTIST

PASTORAL SCENE

Unrecorded artist, ***Pastoral Scene***, 19th century
Pastel on Cream Paper, 13 ½ x 19 ½ in. (34.3 × 48.3 cm)
Gift of Mr. and Mrs. J. Duncan Pitney, 1979
79.793

This landscape has a central motif of a man and woman standing under a large tree surrounded by three cows and a black-and-white spotted dog. A mill with a small body of water is in the background at right. In the distance is a windmill and the ruins of a castle tower.

In the 19th century before the introduction of electricity in homes and farm equipment, farms relied on renewable energy. This painting depicts two forms of renewable energy: a water mill and a windmill, which harness the energy of water and wind to drive mechanisms that can grind grain into flour and operate saws to cut wood to make lumber.

Discussion:

Foster a student-led discussion about this work of art.
Suggested questions to start the discussion:

- Can anyone name forms of renewable energy? Do you see any in this artwork?
- Do we use renewable energy today and is it better than nonrenewable energy?
- Why do you think we don't use more renewable energy in today’s society?

THE NEWARK MUSEUM OF ART

POST-VISIT ACTIVITIES

Post-visit Objectives:

- Enable students to reflect upon and discuss some of the themes from the artwork.
- Through hands-on experiments, have students create the technology depicted in one of the works of art to gain an understanding of how it functions and an appreciation of the inventor's thought process.

1. Reflection

Have students spend a few quiet minutes reviewing their word clouds from the pre-visit activity. Spark a discussion by asking the following questions:

- How has the technology depicted in the artwork impacted today's society?
- What new technology has been introduced during your lifetime and what has been its impact?
- What roles do inventors play in our society?

2. How Stuff Works

Choose one of the experiments below, which are linked to the artwork the students discussed.

A.) The New Experience: How Incandescent Light Bulbs Work
Lewis Latimer, African American inventor of the carbon filament light bulb

Lewis Howard Latimer (September 4, 1848–December 11, 1928) was born in Massachusetts. His parents were escaped enslaved people from Virginia, and his father, George Latimer, was tried as an escaped slave in a famous case that he ultimately won, allowing him and his wife to remain free. At the age of 16, Latimer enlisted to serve in the Civil War for the Union Navy.

It was Latimer who created—and in 1881 patented—a light bulb model that used a carbon filament. A filament is the thin fiber inside a light bulb that the electric current heats to produce incandescent light. Many credit Thomas Edison with the invention of the light bulb. However, many inventors were working on the bulb simultaneously. Edison's bulb used a paper filament that burned in 15 seconds, rendering it useless. Latimer's carbon was further improved upon and burned for up to 1,200 hours, offering the light bulb a practical application and making its production cheaper. Latimer's innovation transformed our culture because electrical light bulbs became affordable for the average American. Latimer also received patents for a water closet (toilet) on railroad cars and drafted the drawings that Alexander Graham Bell used to patent the first telephone in 1876.

Activity:
Students create an incandescent carbon filament light bulb.

Materials:
- 8 D batteries
- Mason jar or other clear glass jar
- Electrical tape
- Pie pan
- Toilet paper tube
- Scissors
- Mechanical pencil refill (.5mm pencil lead)
- 2 Wires with alligator clips

Instructions:
1. Organize students into junior inventor teams of two each.
2. Emphasize safety precautions. Students should never touch any bare or exposed metal in a circuit that is generating electricity.
3. Cut 8 pieces of electrical tape (enough to wrap around a D battery).
4. Tape the batteries together end-to-end in one long column.
5. Cut a 3-inch section of the toilet paper roll (this will be your stand).
6. Clip the alligator clips to the stand.
7. Place the stand in the pie plate.
8. Gently place each end of the pencil lead in the alligator clips.
9. Put the jar over the stand.
10. Attach each end of alligator clips to opposite ends of batteries.

Reference Video

B.) Connecting Us: How Suspension Bridges Work

John Augustus Roebling, German immigrant inventor of suspension bridge wire cables

"It will no longer suit the spirit of the present age to pronounce an undertaking impracticable." —*John Augustus Roebling*

John Augustus Roebling (June 12, 1806–July, 22, 1869) was a a German-born engineer who immigrated to Pittsburgh, PA, in 1831. He perfected the art (and science) of the suspension bridge, a type of bridge in which the road deck is hung (suspended) from cables that are supported by vertical columns. In 1849, after working on the construction of several bridges in western Pennsylvania, Roebling established a "wire rope" factory in Trenton, New Jersey, to manufacture his miraculous product.

Roebling's company specialized in producing cold-drawn steel cables that could support incredible weight, making it possible to build longer bridges than ever before in history. Prior steel cables had been produced using heat, which stretched and weakened the cable. The plant in Trenton completed several smaller projects before being awarded the contract for the Brooklyn Bridge in 1866. Unfortunately, Roebling died in 1867 and did not see the completion of the bridge, but his work and the company was carried on by his sons. The Brooklyn Bridge, with a span of over 1,500 feet, and a total length of more than a mile, was, at the time of its completion in 1883, the longest suspension bridge in the world.

Roebling's company provided steel for the Brooklyn, George Washington, Verrazano-Narrows, and Golden Gate bridges; elevator cables in the Empire State Building and the Washington Monument in Washington, D.C., and the wire used in the original Slinky Toy. These accomplishments stand not only as a monument to engineering and design but also to the industry and determination of one immigrant.

Activity:

Students build a suspension bridge using recycled materials.

Materials:

- Cereal box
- 4 toilet paper tubes
- Blue and green painter's tape
- Bakers twine
- Small rubber bands (Rainbow Loom bands work perfectly)
- Single hole punch
- Scissors
- Matchbox-sized cars

Instructions:

1. Students should be placed in junior engineer teams of two to four members.
2. Cut a strip of cardboard out of a flattened cereal box to make your bridge. You can tape on extra sections if you want to make a really long bridge.
3. Punch holes along the sides of the cardboard leaving a few inches on each end without holes. The un-holed section serves as the ramp to the “ground." Try to line up the holes across the cardboard to help increase stability in the bridge.
4. Thread a rubber band through each hole and loop it back through itself to hold in place.
5. Create bridge towers by cutting two ½-inch slits in one end of each tube. The slits should be slightly off-center and across from each other. See the blue lines in the reference video linked below for guidance.
6. Start taping your racetrack and river. Your river should be a bit narrower than the length of your bridge so the bridge ends can touch the “ground.”
7. Tape down your towers. This is the trickiest part because these towers support all the weight on the bridge just like a real suspension bridge. Be sure that the slits line up with the direction of the bridge.
8. Cut your cables out of a length of bakers twine. Cut them about twice as long as your bridge because you can cut the extra off later.
9. Feed each piece first through the slits in the towers and then through each of the rubber bands. Pull the twine taut until the rubber bands and the bridge feels secure. Tape the ends of the twine to the floor.
10. Tape your road connectors over the bridge.

    Now... PLAY! Have fun testing to see how strong the bridge is. How many cars can it support?

Reference Video

C.) Renewable Energy: How Windmills Work

Victor L. Ochoa, Mexican and immigrant inventor of the Ochoaplane, an adjustable wrench, and electricity-producing windmill

Victor L. Ochoa (1850–1945) born in Ojinaga, Mexico, of Spanish and Scottish ancestry, was an inventor and Mexican revolutionary. He created the Ochoaplane (a plane that flew by flapping its wings like a bird), an electricity-producing windmill, magnetic brakes, an adjustable wrench, and a reversible motor. He was a journalist and founder of El Hispano-American and El Correo del Bravo, a founder of La Union Occidental Mexicana to help Mexicans preserve their language, and corporate president of the International Airship Company of Paterson, New Jersey.

Ochoa immigrated to the United States and lived in Paterson, NJ, and El Paso TX. Before he settled in New Jersey, he had a $50,000 bounty ($1.25 million by today's standards) on his head from the President of Mexico for revolutionary activities. He was imprisoned in Texas. However, the US Government refused to extradite him to Mexico because he was considered a political prisoner. After three years, he was released and became a US citizen.

While Ochoa did not invent the windmill, which had been in use for hundreds of years to provide mechanical power, he recognized the wind as a renewable source of energy and turned it into an electrical force. He attached a dynamo, electrical generator, to a windmill, opening limitless possibilities for rural areas that may not have had, or still do not have, access to power. His design allowed for the storage of energy in batteries that could hold enough power to light a home or run small engines.

Activity:

Have students build a wind turbine and measure the power it puts out.

Materials:

- Small DC toy motor
- 2 pieces of thin electrical wire with alligator clips, each about 50 cm or 20 inches long
- Rubber band
- Stiff ruler
- Cylindrical cork, at least 2 cm or ¾ inch in diameter; alternative to cork: Styrofoam ball
- 4 paper clips

- Clear tape
- Scissors
- 4 pieces of cardboard, each 1 x 2 inches
- For the entire class to share:
  - 1 or 2 small electric fans or hair dryers
  - DC voltmeter
- (Optional) Safety goggles or glasses

Instructions:

1. Divide the class into teams of two junior inventors each.
2. Emphasize safety precautions. Students should never touch any bare or exposed metal in a circuit that is generating electricity.
3. Have students use a rubber band to attach the electric motor to the ruler with the motor shaft positioned at the end of the ruler. The ruler serves as a platform for the wind turbine.
4. Straighten out the lower part of four paper clips.
5. Cut out four 1 x 2 inch pieces of cardboard. Use tape to firmly attach a piece of cardboard to each paper clip.
6. Stick the straightened part of each paper clip into the curved sides of a cork to create four turbine blades. Be sure to space the blades equally around the cork.
7. Push the cork into the motor shaft. Make sure the shaft goes into the exact center of the cork.
8. Rotate the blade in the cork so that it is at a 45° angle to the flat plane of the edge of the ruler. You have completed your wind turbine!
9. In teams, have students bring their wind turbines to the testing station.
10. For one team at a time, use alligator clips to attach the free ends of the wires to a DC voltmeter. While waiting, have other teams work on the worksheet.
11. Start by placing the wind turbine about 12 inches away from the wind source (fan or hair dryer). Adjust the distance, depending on the strength of the wind source.
12. Turn on the wind source and measure the voltage produced. Record on whiteboard.
13. Repeat with the wind turbine at different distances from the wind source.

Reference Video

LINKS

John Sloan

https://www.theartstory.org/movement/ashcan-school/

Joseph Stella

https://www.tate.org.uk/art/art-terms/f/futurism

http://www.newarkmuseumedu.org/learningcenter/image-gallery/voice-city-new-york-interpreted-1929-1922

https://smarthistory.org/joseph-stella-new-york-interpreted/

Lewis Latimer

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https://www.cnn.com/2020/09/04/us/biden-lightbulb-black-man-trnd/index.html

John Augustus Roebling

https://www.loc.gov/item/today-in-history/june-12/

https://www.youtube.com/watch?v=yGYUkRf_RKs

https://www.roeblingmuseum.org/

https://en.wikipedia.org/wiki/Roebling,_New_Jersey

Victor L. Ochoa

https://blog.adafruit.com/2016/10/06/national-hispanic-heritage-month-celebrating-victor-ochoa-hispanicheritagemonth/

https://sciencing.com/build-wind-turbine-kids-6980333.html

http://smithsonianeducation.org/scitech/impacto/graphic/victor/man.html

https://en.wikipedia.org/wiki/Dynamo

AT THE MUSEUM

The Museum supports teachers, administrators, and parents through an array of programs carefully designed to connect different levels of curricula to the Museum collections.

For more, visit: https://newarkmuseumart.org/learn/school-programs/

Field Trips

Field trips are available to students, educators, and parents. Designed to include our permanent collection, Planetarium, and special exhibitions, our programs provide curriculum connection in all subject areas.

Professional Development

The Museum provides professional development opportunities for educators, administrators, and parents.

Residencies

For art and STEM residencies, the Museum partners with schools with teaching artists to create projects that connect to Museum objects.

Scout Programs

Each onsite experience is a fun and educational way to earn badges while connecting with the global offerings of the Museum.

Birthday Parties

With the magic of the Museum as a backdrop, our educators lead a one-of-a-kind activity for your child and your guests.

Camp NMOA

Summer begins here! Join us for six weeks of building community through project-based learning where campers can develop their skills in art and science.

ABOUT THE MUSEUM

We welcome everyone with inclusive experiences that spark curiosity and foster community.

The Newark Museum of Art, in Newark, Essex County, New Jersey, is the state's largest museum. It holds fine collections of American art, decorative arts, contemporary art, and arts of Asia, Africa, the Americas, and the ancient world. Its extensive collections of American art include works by Hiram Powers, Thomas Cole, John Singer Sargent, Albert Bierstadt, Frederick Church, Childe Hassam, Mary Cassatt, Edward Hopper, Georgia O'Keeffe, Joseph Stella, Tony Smith, and Frank Stella.

Founding Director John Cotton Dana believed that museums were established to promote the appreciation, understanding, and enjoyment of the arts and sciences. Together with a group of public officials, prominent businessmen, and local collectors, he established the Museum in 1909 at the Newark Public Library. He provided the intellectual leadership that made it one of the most progressive cultural institutions in the country.

LEARNING STANDARDS

1.5.5.Re8a; 1.5.5.Cn11a; 1.5.12acc.Cn11b; 3-5-ETS1-1 ; 8.2.5.ED.1; 8.2.5.ED.2; 8.2.5.ED.3; 8.2.5.ED.4; 8.2.5.ED.5; 8.2.5.ITH.1: ; 8.2.5.ITH.2; 8.2.5.ITH.3; 8.2.5.ITH.4; 8.2.5.ETW.4; 8.2.5.ETW.5; 8.2.5.EC.1; 6.1.5.CivicsCM.5; 6.1.5.GeoHE.2: 6.1.5.EconNM.3; 6.1.5.EconNM.4; 6.1.5.HistoryCC.9;

IMAGE CITATIONS

John Sloan
http://photography.si.edu/SearchImage.aspx?t=5&id=3846&q=aaa_charscrs_4354

Cover Photography by <u>Mike Peters</u>