MADE FOR LIVING: OBJECTS OF DESIGN IN MoMA'S COLLECTION

A Guide for Educators

Department of Education of The Museum of Modern Art

MADE FOR LIVING: OBJECTS OF DESIGN IN MoMA'S COLLECTION

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A NOTE TO EDUCATORS

This guide explores design from The Museum of Modern Art's rich collection. It is informed by issues that arise from the selected works, but its organization and lesson topics are created with the school curriculum in mind, with particular application to social studies, visual art, history, science, and language arts. Lessons are accompanied by writing, research, and hands-on, art-based activities that encourage students to make connections between design, the visual arts, and other disciplines. This guide will explore form and function as related to the selected design objects while also considering designers' interest in the aesthetic resonance of their work.

The guide's purpose is not just to explicate works in MoMA's collection but also to demonstrate how images and historical information can be integrated into numerous subject areas and skill bases taught in the classroom. Students will be introduced to significant ideas in art and culture and will be able to practice observation, articulation, and discussion skills and further develop their visual literacy.

USING THE EDUCATOR GUIDE

The six lessons that compose this guide—**Everyday Marvels**, **Take a Seat: Exploring Chair Design**, **Simple Machines**, **Exploring the Design Process: The Work of Charles and Ray Eames**, **Design That Makes a Difference: Focus on Shelters and Water**, and **Materials and Process: Plastics**—may be used sequentially or as independent units. An introduction to the key principles of each lesson is followed by a close examination of each work, including formal analysis, historical context, and biographical information about the designer or artist. Discussion questions lead students through formal analysis of the artwork and seek to create connections between information and visual evidence. The activity or project that concludes each lesson encourages students to synthesize what they have learned about each work and carries the lesson into the broader curriculum or relates it to skills students are practicing in the classroom.

IMAGES

All of the questions, discussions, and activities in this guide are based on the images on the accompanying CD-ROM. Carefully examine each image prior to showing it to your students. Your classroom should be equipped with a computer and LCD projector.

ACTIVITIES

The Activities section is designed to help students make connections between their own experiences and the concepts presented in the lesson. Through these activities, students will begin to develop a language for discussing and looking at architecture and art. Please feel free to tailor the activities to the age level of your students.

RESEARCH PROJECTS

In many cases, the materials in this guide will provide opportunities for in-depth research on specific artists or artistic movements. We have suggested some topics, and we encourage you to add your own.

FOR FURTHER CONSIDERATION AND SELECTED BIBLIOGRAPHY AND RESOURCES

The For Further Consideration section suggests additional discussion questions, research projects, and ideas for field trips. A Bibliography and Resources section is also provided, for teachers and students to use in conducting research. The resources recommended in these pages provide more classroom activities and further information on the artists and artworks in this guide and on general historical topics.

GLOSSARY

A glossary of architectural and art-historical terms (bolded upon first mention in each lesson) is included at the end of the guide.

IMAGE ONE: Müholos, Ltd., company design. British, 1910–30. Hair Dryer. c. 1910–30. Brass and metal, overall: 56 x 20 x 25" (142.2 x 50.8 x 63.5 cm). Manufactured by Müholos, SAS Leather Machine, London. Marshall Cogan Purchase Fund

IMAGE TWO: Reinhold Weiss. German, born 1934. Braun AG. Germany, 1921. Hair Dryer (model HLD 2). 1964. Plastic and metal casing, $1\frac{7}{8}$ x $5\frac{1}{4}$ x $3\frac{3}{4}$" (4.8 x 13.3 x 9.5 cm). Gift of the manufacturer

IMAGE THREE: Morison S. Cousins. American, 1934–2001. Michael Alan Cousins. American, born 1983. The Gillette Company. USA. Promax Compact Hair Dryer. Lexan casing, $6\frac{5}{8}$ x $2\frac{5}{16}$ x $6\frac{1}{4}$" (16.8 x 5.9 x 15.9 cm). Gift of the manufacturer

DESIGN IS A NOUN

Unless you live in the wilderness, you are a resident of a human-made environment. Everywhere you look, you can find something that is designed. From the time you wake up to the time you go to sleep, you are sure to encounter design in your everyday life. We are surrounded by design, whether it be objects, spaces, landscapes and streetscapes, or communications or transportation systems.

Design is not an instantaneous act or event. Sidewalks and streets do not fall from the sky and land in their proper places. Our toothbrushes do not magically appear in our hands when we need them. Someone is responsible for all the things we consume, use, and interact with everyday. Every moment, we encounter a set of solutions to a problem that has been considered by someone.

Have each of your students take out a sheet of paper and write “Design is” at the top. Next, have your students look around the classroom and make note of all the different examples of design that they see. Have them write each one of these examples down on their paper. These could be desks, chairs, books, posters, and clothing, for example. Lead a group discussion with your students, and have them share their findings with the class. Take notes on the board and begin to classify the different types of design that your students refer to.

Books are an example of graphic design, while computers and pencils are considered **industrial design**. You could broaden this exploration to the design of the classroom, which is interior design, or the school building itself, which is architecture.

DESIGN IS A VERB

“Design” does not only refer to places and things; it is also the process of planning, evaluating, and implementing a plan or solution to a problem. Designers often start with a problem: For example, a school that needs sturdy, affordable chairs for students. The first step in the design process is a brainstorm of possible solutions. This brainstorm could take the form of words, sketches, or even photographs that articulate the designer’s ideas. Once the ideas have been expressed, the designer chooses the best solution for the problem at hand, then consults an engineer, who helps produce a sample. That sample is evaluated, sometimes through user testing, to ensure that the design solution is functionally and aesthetically viable.

- **Ask your students if they think there is value in testing an idea. Have they ever experimented with a new way of doing something?**

Designers navigate between the aesthetics and functionality of an object through each and every stage of the process from concept to final product. According to designer and artist Ray Eames, “The looks good can change, but what works, works.”[1]

- **Ask your students if they have ever applied this kind of process in their lives. Have them think of an object they consider to be an example of good design and describe its form and function. Ask them if the object they selected meets their needs in terms of form and function.**

As **consumers** of everyday objects, we play an important role in the design process. Although they don’t know each and every one of us personally, designers often look to consumers to evaluate and respond to the things they create, proving their functionality. If consumers are not satisfied with the way something works, they probably won’t want to use it, and designers are keenly aware of this fact. From deciding on a new shape or color for a cell phone to how wide to make the seats on the subway, design firms rely heavily on market research and consumer input, conducting extensive research.

1. Ray Eames, quoted in “The Work of Charles and Ray Eames: Furniture” (Library of Congress/Vitra Design Museum), http://www.loc.gov/exhibits/eames/furniture.html.

Each design problem or situation has a unique set of criteria that must be addressed. Identifying needs or problems, brainstorming possible solutions, testing ideas, and evaluating them are all part of the design process. In some cases an existing idea is refined and in other cases a totally new concept is created, but the processes are similar. With every year that passes, technologies of rendering and manufacturing change. Designers need to be aware of these new and emerging technologies and of how they could affect the design and production of five, five hundred, or five hundred thousand objects.

OUTLINE OF THE DESIGN PROCESS

Design Process:

Defining problems
Gathering information and research
Generating solutions
Evaluating and selecting appropriate solutions
Implementing choices
Evaluation
Integration of feedback

You can lead your own design critique by bringing objects into the classroom. Pencils, toothbrushes, and cell phones are great examples of how the look and feel of things change over time. Ask your students why the way these objects look has changed over time. Why not have all things look the same? Break your students into teams and have them debate whether the objects they selected are examples of "good" design or "bad" design. Have them start this debate as a group, agreeing on what constitutes good or bad design. Is it easy or difficult to arrive at a consensus?

To further this conversation, teachers and students can browse and search MoMA's online collection, at www.moma.org/collection, for more examples of design. Consult the bibliography section of this guide for other resources about the history of design and MoMA's design collection.

IMAGE-BASED DISCUSSION

- **Show your students Hair Dryer (Image One), by Müholos, Ltd., but do not tell them what it is called. Ask them to describe the object they see. Have them talk about the visual elements they notice, including color, form, and shape. Next, have your students guess what the object is made of and what its function or purpose is.**

Once the students have made guesses, reveal to them that this object is a hair dryer. It is made from brass and other metal and is dated c. 1910–30. You may also share the name of its designer and manufacturer. Tell your students the dimensions of the object. You may want to chart the dimensions on the board to give your students a sense of its scale.

- **Repeat this process of object observation with Hair Dryer (model HLD 2) (Image Two) and Promax Compact Hair Dryer (Image Three). Next, print out all three images (without the label information), and have your students work in pairs to observe the objects and make comparative statements. Have them consider size, shape, and material and what it might be like to use one of these hair dryers. How might the object feel in their hand? Would one feel heavier or lighter than another? If so, why? Does the form or shape of each object relate to its function? If so, how? Have your students try to put them in chronological order, earliest to latest.**

- **Lead a group discussion based on the findings of each pair. You can chart their comments and assertions on the board. Next, ask your students to vote on which design they like the best. Ask each student to cite an example of an object that he or she uses in everyday life whose function has stayed the same while its form has changed.**

- **Ask your students if they were surprised by any of the information they learned about these objects. Do these objects look like hair dryers that they have seen or used?**

ACTIVITIES

You Are a Designer

Have your students pretend to be industrial designers. Have them start by making rough sketches of forms that they think might be good for a new hair dryer. Have them select the sketch they like the best and write a brief description about their new hair dryer. Is its function similar to that of traditional hair dryers? Does it have any special features, such as a built-in comb or brush? Encourage your students to think up ideas with the understanding that the engineering of how the object works could be addressed later in the design process. Would it be designed for one specific person or many?

Next, allow your students to use mixed mediums to further design or decorate their forms with lines, shapes, patterns, colors, or texture. Have them present their rough sketches and final artwork to each other then reflect on their experience as it relates to the process of design. Which parts were easy? Which were difficult?

If you wish to extend this project, you could ask your students to develop advertisements (copy and imagery) for their new designs. In addition, you could discuss the role of graphic design and advertising as it relates to product and brand identity.

Design Detective

Create a worksheet your students can use to record the different kinds of design they encounter on a given day. Have them identify design in the form of places, products, and systems at home, commuting to school, and at school. Have them start this exercise at home, filling in the boxes with examples of design that relate to the different categories. For example, on the way to school a student may take a bus, which falls under systems. While on the way to the bus stop he or she might pass a street sign, which falls under communication. The worksheet should be large enough to accommodate multiple examples in each box.

Once the students have completed the worksheet, have them journal about their experience. As a group, discuss and debate some of the entries they made. Ask your students if they noticed things that they had never seen or considered before. Ask your students to pick something they saw that could be improved upon in the way it works or looks and have them share their findings. When the lesson is complete, ask your students if they have come to any new conclusions about the role of design in their lives. Do they consider it significant? Why, or why not?

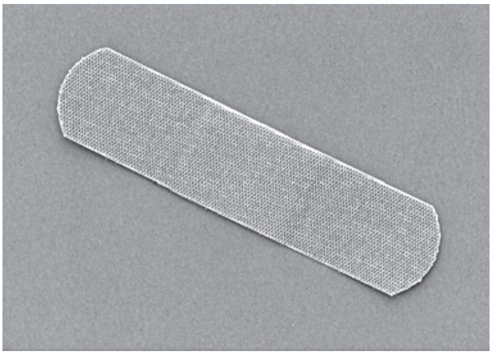


IMAGE FOUR: Earle Dickson. American, 1891–1936. Johnson & Johnson Consumer Companies, Inc. USA, est. 1886. Band-Aid. 1921. Adhesive bandage and cotton, unwrapped: 1 x 3" (2.5 x 7.6 cm), wrapped: 3 3/4 x 1 1/2" (9.5 x 3.8 cm). Gift of the manufacturer

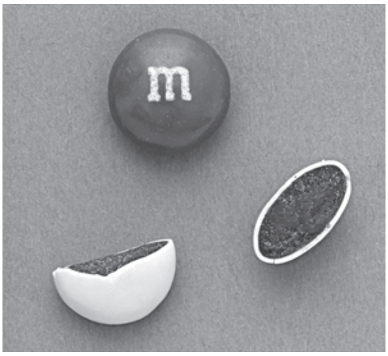


IMAGE FIVE: Forrest Mars. American, 1904–99. Mars, Inc. USA, est. 1941. M&Ms. Late 1930s. Milk chocolate coated with a candy shell, 3/8 x diam. 1/2" (1 x 1.3 cm). Gift of the manufacturer

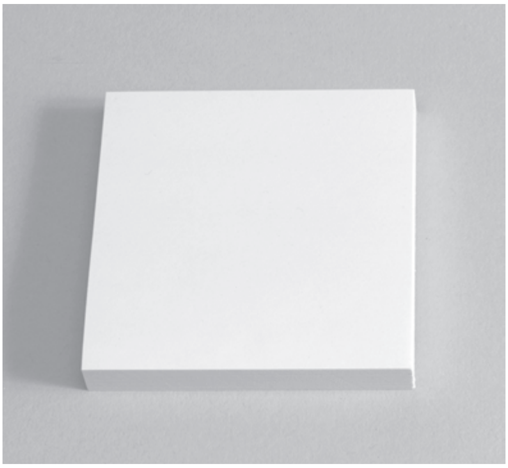


IMAGE SIX: Art Fry. American, born 1931. Spencer Silver. American, born 1941. 3M. USA, est. 1902. Post-it® Note. c. 1977. Paper and adhesive, 2 7/8 x 2 7/8" (7.3 x 7.3 cm). Purchase

LESSON OBJECTIVES

- **Students will consider the role of design in daily life and think about the objects they use every day.**

- **Students will consider how shape, form, and materials impact design.**

- **Students will practice problem solving and critical thinking.**

- **Students will consider the meaning of innovation.**

INTRODUCTION

Most of the objects that we use in our daily lives have been designed by someone. Many, we take for granted. This lesson will examine some small but revolutionary objects that have changed the way we interact with the world around us, including the Band-Aid, M&M candies, and Post-It Notes. Bring in examples of these objects to share with your class. You may also print or project Images Four, Five, and Six to use with this lesson.

INTRODUCTORY DISCUSSION

- **Show your students the Band-Aid (Image Four), by Earle Dickson and Johnson & Johnson Consumer Companies, Inc. Ask them to raise their hands if they have ever used one. What problem did it solve? Ask them to describe what materials these bandages are made of. What shapes do they come in? Why? How do they work? What challenges do these small bandages have to deal with?**

The Band-Aid was developed in 1921 by Earle Dickson, who worked as a cotton buyer at the company Johnson & Johnson. His wife often burned herself or cut her fingers when she was cooking. At that time, people made bandages from gauze and adhesive. Dickson noticed that these did not stick to his wife's fingers for long, so he decided to create better bandages. He took an adhesive strip, placed squares of cotton on it, and covered the whole thing with crinoline, a stiff fabric, to make it sterile. He shared his design idea with his boss, James Johnson, who decided to manufacture his invention. Over 100 million Band-Aids have been manufactured since then.[2] Band-Aids often work well, despite sweat and water. They don't stick to the wound and are removable, inexpensive, and flexible.

- **Next, show your students the M&Ms (Image Five), by Forrest Mars and Mars, Inc. Ask your students what memories or associations they have with M&Ms. What kind of advertising do they associate with M&Ms? Can they recall the advertising slogan?**

"It melts in your mouth, not in your hands" was trademarked in 1954. However, legend has it that during the Spanish Civil War (1936–39), Forrest Mars, Sr. (the first M in M&Ms) visited Spain, where he saw soldiers eating small chocolates with a hard, sugary coating that prevented the candies from melting. Back in his kitchen, he invented the recipe for M&Ms. At first they were sold in cardboard tubes and marketed to the military as a snack that could travel well in different climates. Many soldiers in World War II ate these candies. By the late 1940s, they were widely available to the public. In 1981 the first space-shuttle astronauts brought M&Ms with them on their flight.[3]

- **Ask your students what their favorite foods are. How would they package them if they were to transport them to a desert? The Arctic? Space? Underwater? How would the design of the package protect the food?**

2. Paola Antonelli, *Humble Masterpieces: Everyday Marvels of Design* (New York: Harper Collins Publishers, 2005), 175.
3. Ibid., 87.

- **Next, show your students the Post-it Note (Image Six), by Art Fry, Spencer Silver, and 3M. Ask them to work in groups of four and debate whether or not this object belongs in a design museum. Half the group should be pro and half con. Have each group summarize its main idea, and then have a larger group discussion. When have your students used Post-it Notes? For what purposes? What do they notice about their form? Function?**

IMAGE-BASED DISCUSSION

While Spencer Silver, a research scientist at the company 3M, was conducting experiments with adhesives in 1968, he created one that was removable. It was composed of tiny spheres that retained their shapes and which, although sticky individually, did not cause the paper to stick permanently. This discovery was not utilized until many years later, when Art Fry, a product development researcher at 3M, used it to solve a problem. When Fry sang in his church choir, he kept losing his place in his hymnal. To combat this problem, he combined Silver's adhesive with paper and made a reusable bookmark. 3M manufactured this innovation, and it was made available to the public in 1980.The original Post-it Note was square and was colored yellow to catch attention. Now Post-it Notes come in eight standard sizes and sixty-two colors.

In the introduction to the exhibition catalogue *Humble Masterpieces: Everyday Marvels of Design*, MoMA curator Paola Antonelli states, "Hypertext on a refrigerator's door, the Post-it shook the world."[4] The Post-it Note is an object that has had a significant impact on our world. It is useful, simple, affordable, and has changed the way people organize their lives.

ACTIVITIES

You Are the Expert! Classroom Exhibition

Ask your students to go home and take a look at the small objects that are part of their everyday lives. Have them select one that they think is remarkable and research it. Where did it come from? Why was it invented? What materials is it made of? What problem does it solve? Ask them to pretend to be a museum curator who is including the object in an exhibition and write a wall label describing the object. Then have them bring in their objects and wall labels and have an exhibition in your classroom.

Marketing Madness

Ask your students to work in small groups to invent their own candy. What is it made of? What is special about it? What shape is it? They should draw a picture of their invention and come up with a marketing plan and an advertising poster. What is it called? What do they want to draw attention to? Who is their audience?

"Humble Masterpieces" in MoMA's collection

MoMA has many other "humble masterpieces" in its collection. Assign students one object from the following list to research. When was it invented? By whom? What problem does it solve? How does it solve it? Have each student come up with a creative way to teach the rest of the class about his or her object, such as a game, a PowerPoint presentation, or a skit.

Assign your students one of the following: Swiss Army Knife, spaghetti, chopsticks, baseball, bubble wrap, Swatch wristwatch, pencil, ice-cream cone, spark plug, sugar cube, flat-bottomed brown-paper grocery bag, Slinky, dominoes, bar code, tweezers, bottle cap, Bic Cristal pen, Q-tips, fortune cookie, condom, zipper, Frisbee, Dixie paper cups, incandescent lightbulb, safety pin, Duracell AA battery, numbered dice, ping-pong paddle, guitar pick, Rubik's Cube puzzle, boomerang, soft contact lenses, friction match, flip-flop, Lego building bricks, paper clip, Phillips head screw, white cotton t-shirt.

4. Ibid., 2.

LESSON TWO: Take a Seat: Exploring Chair Design

IMAGE SEVEN: Charles Rennie Mackintosh. British, 1868–1928. Side Chair. 1897. Oak and silk, 54 3/8 x 20 x 18" (138.1 x 50.8 x 45.7 cm), seat h. 17" (43.2 cm). Gift of the Glasgow School of Art

IMAGE EIGHT: Eero Saarinen. American, born Finland. 1910–1961. Tulip Armchair (model 150). 1955–56. Fiberglass-reinforced polyester and cast aluminum, 31 1/2 x 25 1/4 x 23 1/2" (80 x 64.1 x 59.7 cm). Manufactured by Knoll International, Inc., New York. Gift of the manufacturer

IMAGE NINE: Herbert Matter. American, born Switzerland. 1907–1984. *K(noll) Single Pedestal Furniture Designed By Eero Saarinen.* c. 1957. Offset lithograph. 45 x 26" (114.2 x 66 cm). Gift of the designer

IMAGE TEN: Josef Hoffmann. Austrian, 1870–1956. Sitzmaschine Chair with Adjustable Back (model 670). c. 1905. Bent beechwood and sycamore panels, 43 1/2 x 28 1/4 x 32" (110.5 x 71.8 x 81.3 cm). Manufactured by J. & J. Kohn, Vienna. Gift of Jo Carole and Ronald S. Lauder

IMAGE ELEVEN: Kazuo Kawasaki. Japanese, born 1949. Carna Folding Wheelchair. 1989. Titanium, rubber, and aluminum honeycomb, 33 x 22 x 35 1/4" (83.8 x 55.9 x 89.5 cm). Manufactured by SIG Workshop Co., Ltd., Ishikawa, Japan. Gift of the designer

IMAGE TWELVE: Fernando Campana. Brazilian, born 1961. Humberto Campana. Brazilian, born 1953. Vermelha Chair. 1993. Iron with epoxy coating, aluminum, and cord, 31 x 29 1/8 x 22 3/4" (78.7 x 74 x 57.8 cm). Manufactured by Edra Mazzei, Pisa, Italy. Gift of Patricia Phelps de Cisneros. © 2008 Fernando Campana and Humberto Campana

IMAGE THIRTEEN: Tokujin Yoshioka. Japanese, born 1967. Honey-Pop Armchair. 2000. Paper, .1 unfolded: 31 1/4 x 32 x 32" (79.4 x 81.3 x 81.3 cm), .2 folded: 31 1/4 x 36 1/2 x 3/4" (79.4 x 92.7 x 1.9 cm). Manufactured by Tokujin Yoshioka. Gift of the designer. © 2008 Tokujun Yoshioka

LESSON OBJECTIVES

- **Students will learn the following vocabulary: constraints, organic, geometric, and scale.**
- **Students will become familiar with chair design and production.**
- **Students will learn about chairs from the nineteenth, twentieth, and twenty-first centuries.**
- **Students will consider the role of inspiration in the design process.**
- **Students will consider the use of material as it relates to form and function in design.**

INTRODUCTION

Ask your students to define "innovation." Whom do they consider to be innovators? What are their characteristics? Make a list of these ideas on the board. Ask them which of the things they use every day are innovative. Why? The history of the chair goes back two thousand years. Although its style and design have changed, its core function has remained the same. In its many different shapes and forms, a chair is an object that "seats" us. Some of the earliest examples of chairs, across cultures, are ceremonial thrones designed for royalty. In these cases, they are often one-of-a-kind objects, custom made for one specific person. Technological innovation starting in the late nineteenth century allowed chair designers to break from tradition and incorporate new materials and production methods. Now, most of the chairs we use on a regular basis are designed and mass produced for consumers of all kinds to purchase. In the course of our daily lives, we use a variety of chairs—on buses and trains, and at school, work, and home. Development in technology and materials continues to shape the ways chairs are designed and produced. And, as with all design, inspiration plays a vital role in the process. This lesson explores a selection of chairs from MoMA's collection (which includes over 350) through the lenses of inspiration, innovation, and materials.

INTRODUCTORY DISCUSSION

Form and function interact very closely in the design of chairs, and mediating between the two has long been a challenge. "For designers, chairs are a ritual of initiation" writes Paola Antonelli, MoMA design curator. "In chairs more than in any other object, human beings are the unit of measure and designers are forced to walk a fine line between standardization and personalization."[5]

- **Using a classroom chair as an example, ask your students to compare its design to their own bodies. What are the similarities? What are the differences?**

The relationship between the human form and that of the chair requires careful consideration. Like the human body, chairs have arms, legs, and a back. But not all chairs look and work the same way.

- **Have your students give examples of the different kinds of seating they encounter during the course of a given day, and record their responses on the board. Is there something that all these different types of seating have in common? Ask your students if they have a favorite chair. What is their favorite aspect of the design? The way it looks? Works?**

There are many factors that must be considered in the design of a chair. The designer must consider who will be using it, and where. In some cases, such as a seat on an airplane, there might not be one specific user. In other cases, the chair might be designed for a single user: a custom wheelchair, for example. Each chair has its own set of criteria, or constraints, that govern the process of its design.

5. Paola Antonelli, *Objects of Design* (New York: The Museum of Modern Art, 2003), 280.

- **Have your students revisit their lists of seating, discussing what specific factors might pertain to each example.**

There are more chairs than any other single type of object in MoMA's design collection. You and your students can research the history of the chair through MoMA's online collection, at www.moma.org/collection. To get a list of all the chairs in MoMA's collection, search the online collection by typing "chair" in the Title field. You can search The Metropolitan Museum of Art's Timeline of Art History, at www.metmuseum.org/toah/splash.htm, to see premodern and other historical chairs from centuries past.

Have your students consider the form and function of the objects in each of the following images. In addition to aesthetics and function, have them consider scale, weight, and materials to gain a greater understanding of what they are seeing.

IMAGE-BASED DISCUSSION

- **Show your students the Side Chair (Image Seven), by Charles Rennie Mackintosh. Have them describe what they see by establishing a visual vocabulary: line, shape, color, texture, pattern, and material. Ask your students if the shapes and lines remind them of anything they have seen in the built or natural world. Have each of your students make a sketch of this chair, articulating the different shapes that make up its form.**

Tell your students that the Side Chair was designed in 1897 by the architect and designer Charles Rennie Mackintosh. Mackintosh designed buildings, interiors, textiles, and furnishings. He was inspired by the **Arts and Crafts** movement, which emphasized natural, organic forms.

- **Ask your students to define organic and geometric forms and give examples of each. Next, show your students examples: Leaves, plants, and animals have organic shapes; squares and rectangles are good examples of geometric form.**

A side chair is armless and is often used at a dining table. This chair is made out of oak and silk and is approximately four feet tall, with a seat that is seventeen inches deep. Mackintosh designed this chair for limited production, to be used in a tearoom of one of his patrons, Catherine Cranston. It was intended to be one of several chairs placed around a table in the center of the room.

- **Ask your students to imagine what it would be like to sit in a chair like this. Would it be comfortable? Why, or why not?**

- **Use a similar-sized object or even string or construction paper to give your students an idea of the chair's size. Have them compare the scale of the chair to that of their own bodies. Ask your students if they can identify which parts of the chair are made out of silk and which are made out of wood. Once you have shared and discussed this information, ask your students again if they think this chair would be comfortable. Why, or why not?**

By creating a very tall, high-backed chair, Mackintosh hoped to obscure the sides of the luncheon room and create a smaller, private environment for those seated at the table.

To further this discussion, do an image search online for photographs of Catherine Cranston's Argyle Street Tearooms.

- **Next, show your students the Tulip Armchair (model 150) (Image Eight), by Eero Saarinen, but do not tell them what it is called. Have your students compare the Tulip Armchair to the Side Chair. As they describe the similarities and differences, have them continue to use the vocabulary you established in the first part of this lesson. Ask your students to guess the materials the chair is made of based on how it looks. Ask your students if the shape of the chair is reminiscent of any forms that they have seen before. After some time, reveal its name. Ask your students if this piece of information provides any insight about the object.**

The Tulip Armchair was designed by Eero Saarinen in 1955–56. It is made out of fiberglass and cast aluminum. Like Mackintosh, Saarinen was inspired by natural, organic shapes, like that of the tulip flower. He wanted to design a chair that would better people's lives.

- **Ask your students if they can imagine what it would be like to sit in this chair. Can they see anything in Saarinen's chair that might make it a tool for bettering people's everyday lives?**

Like Mackintosh, Saarinen was an architect and designer who shaped objects as well as the spaces they went in. In the Tulip Armchair, Saarinen wanted to create a simple and aesthetically pleasing structure. He expressed his views in the following statement: "The undercarriage of chairs and tables in a typical interior makes an ugly, confusing, unrestful world. I wanted to clear up the slum of the legs. I wanted to make the chair all one thing again."[6]

- **Share this information with your students and have them look around your classroom or school at different examples of chairs. Do they agree or disagree with Saarinen's opinion? Does Saarinen's design "unclutter" the look of the chair? How has he made the chair "all one thing again"? Ask your students to imagine what kind of environment this chair might be used in. Would it be an inside or outside space?**

Saarinen's Tulip Armchair was mass produced and intended for use in domestic or commercial interior spaces.

- **Have your students focus on the base of the chair and it compare it with Mackintosh's Side Chair. What is the relationship between the seat and the base? Ask your students if they can determine how the components are joined together by looking at this image.**

Saarinen created a single pedestal leg with a wide base to provide stability for the chair. It took several iterations to arrive at this design, as his first base models were not stable enough to support the reinforced-plastic shell seat. Although, visually, this design is "one piece, in one material," its sculpted, fiberglass shell seat attaches by way of a screw system into its aluminum stem.[7] In addition to the Tulip Armchair, Saarinnen applied this design to a group of pedestal tables and chairs, which varied in size and scale. This group of furniture was mass produced by the Knoll furniture company, and it is still in production today.

- **Show your students *K(noll) Single Pedestal Furniture Designed By Eero Saarinen* (Image Nine), by Herbert Matter. This is an advertising poster commissioned by Knoll for this collection of pedestal furniture. Ask your students to comment on the collection of pieces. How do they coincide with Saarinen's design inspiration and philosophy?**

- **Divide your students into pairs and give each pair an image of the Sitzmaschine Chair with Adjustable Back (Image Ten), by Josef Hoffmann. Have them look at the image and create a sketch of the environment in which they envision the object being used. Post the sketches around the room, gallery style, and allow the students to view each other's work. Have a discussion about how they represented the environments and how the environments relate to the chair.**

6. Eero Saarinen, quoted in ibid, 199.
7. Ibid.

The Sitzmaschine Chair, made out of bent beechwood and sycamore panels, was designed in 1905 by Josef Hoffmann. Hoffmann, who lived and worked in Vienna, also designed buildings and interior spaces. He designed the Sitzmaschine Chair—or, "machine for sitting"—for the Purkersdorf Sanatorium in Vienna. In addition to the chair, Hoffmann designed the sanatorium building. This was one of the first important commissions given to the **Wiener Werkstätte**, a collaborative working group Hoffmann was a member of. The Wiener Werkstätte was influenced by the English Arts and Crafts movement, which promoted good design and high-quality craftsmanship.

- **Have your students look at the image of the Sitzmaschine Chair again, focusing on its adjustability. Have them refer to the design of the chair as they explain the ways in which this chair can change position. What parts of the chair move in order to transform the object?**

Draw your students' attention to the wooden rod placed behind the back of the chair. Show them that it is not permanently fixed there, but rather rests between mushroom-shaped pegs that are attached to the arms of the chair and spaced wide enough to allow the rod to stay in place. If the rod is placed further up on the arms, the back inclines, allowing for a more upright posture. When the rod is placed further down toward the floor, the back reclines.

- **Ask your students to consider what the chair's adjustability might mean for the user. Why is adjustability a positive feature of the chair? Is there a relationship between how the chair looks and how it works? Is there a relationship between the design of the chair and the environment for which it was created? If so, what is the nature of that relationship?**

- **Next, show your students the Carna Folding Wheelchair (Image Eleven), by Kazuo Kawasaki. Without giving them the title or any information about the chair, have your students work in pairs to come up with a list of similarities and differences between this chair and the Sitzmaschine Chair. Ask them to write down any questions they have about this object. Ask your students to consider what materials were used to make this chair.**

This wheelchair was designed by Japanese industrial designer Kazuo Kawasaki. It is made out of titanium, rubber, and aluminum.

- **After giving your students this information, ask them if it answered any of their questions. Ask your students if they think that the process of designing a wheelchair would be different than designing the Sitzmaschine Chair. Why, or why not? What factors about the user would the designer have to consider in order to complete the design? Do the materials of the wheelchair relate to its function? If so, how?**

Kawasaki was injured in an accident when he was twenty-eight years old, resulting in the paralysis of his legs. He originally conceived the Carna Folding Wheelchair for himself: "I realized that by designing a wheelchair that closely met my needs, I could create a functional design that other people with similar needs might use."[8]

Titanium forms a strong but light frame, weighing thirteen pounds in total. The wheels are oversized for greater stability. The seat and the back are easily removable and foldable, allowing the chair to close for portability.

- **Ask your students why portability and lightness are important features for a wheelchair. How might this object function differently if it were made out of wood or a heavier metal, such as steel?**

8. Kazuo Kawasaki, quoted in "Adaptive Environments" (Adaptive Environments), www.adaptiveenvironments.org/adp/profiles/12_Kawasaki.php (accessed March 2008)

- **Have your students look at the images of the Sitzmaschine Chair and the Carna Folding Wheelchair side by side. What things are similar about these objects' forms and functions? What are different?**

- **Show your students the Vermelha Chair (Image Twelve), by Fernando and Humberto Campana, and the Honey-Pop Armchair (Image Thirteen), by Tokujin Yoshioka. Lead a dis-cussion with your class about the design of these objects, using the vocabulary and close-looking skills developed over the course of this lesson. Ask your students to consider what the designers were thinking about when they envisioned these objects.**

The Vermelha Chair is made of iron, aluminum, and cord. When asked to describe their design process, the Campana brothers responded this way:

> We always say that first comes the material, then the form, and finally we elaborate the function of the product by studying its ergonomics, limitations, and capabilities. The streets of São Paulo are a sort of laboratory for our designs. Whenever we need inspiration, we rely on the chaos and beauty of the city we live in. A good example of this is the Vermelha Chair. The idea emerged when we bought a large bunch of rope from a street stall and brought it back to the studio. When we placed it on a table, we observed it deconstructing before our eyes. At that moment we both looked at each other and almost simultaneously remarked, "This is the chair we want to build. It is a representation of Brazil in its beautiful chaos and deconstructiveness." To replicate this deconstruction in the chair, we were careful to study the construction of the mess of ropes.[9]

For this design, the Campanas were inspired by materials and the customs and traditions of Brazilian weaving. Parts of the chair are created by machine and others by hand.

- **Ask your students to consider which parts of the chair are made by hand and which parts by machine.**

Once the metal frame is completed by machine-based methods of production, factory workers weave the cotton cord onto it, making the seat. They have found the weaving process challenging, as it is the opposite of the highly technical and systematic processes they are used to.

- **Ask your students what techniques and strategies they think are used to weave the cord seat of this chair.**

In addition to cord, the Campana brothers continue to use recycled materials, such as cardboard and garden hose, in their designs for chairs.

- **Next, have your students focus on the Honey-Pop Armchair.**

- **Ask your students to describe the two objects that they see in this image. What is the relationship between these two objects? How can they tell?**

This is two different views of the same chair. The chair on the left is unfolded, or expanded, and the chair on the right is folded. The chair is packed and shipped in a folded state and unfolded after it is unpacked.

- **Ask your students to consider why Yoshioka designed the chair this way. What material has he chosen? Is there a correlation between the material and the form? Why, or why not?**

9. Fernando and Humberto Campana, interview by Design Museum, London, www.designmuseum.org/design/fernando-humberto-campana.

This chair is made entirely of paper similar to the kind used for Japanese lanterns. It flattens just like a lantern and can be spread open like an accordion to make a seat. When the user first sits in the chair, he or she leaves a permanent impression. Yoshioka's concept was born from his desire to use materials in new and different ways, not from the idea of creating a specific form. The final form of the Honey-Pop Chair is not created until the user sits down for the first time.

- **Ask your students to imagine what it would be like to sit in this chair. Would it be comfortable? If they owned a chair like this, would they allow other people to use it? Why, or why not? How is the final form a surprise? How has Yoshioka used paper in a new and different way?**

ACTIVITIES

Inspired Design

Have your students make a list of objects, ideas, or people that inspire them then use this list as a basis for designing a chair that reflects the qualities of the inspiration they described. Have your students consider the materials they would use, and why. How would their chair be constructed? By hand? By machine? Both?

A Chair for an Astronaut

Develop a variety of chair-design challenges for your students. For example, how would they design a recliner chair for an astronaut to use in space? Give each student (or group of students) a different challenge and some materials to work with. Ask them to create two-dimensional or three-dimensional representations of their ideas, using the materials they have been given. In addition, have your students create statements that outline their approach to the design process and then present their work to the class. Other students can ask questions and give feedback on their designs.

Design Research

Many of the chairs included in this lesson are still in production today. Have your students research some additional works by these designers; there are many online sources of information about contemporary designers. Have them present their research, highlighting one (or several) ideas discussed in this lesson.

LESSON THREE: Simple Machines

IMAGE FOURTEEN: Sven Wingquist. Swedish, 1876–1953. SKF Industries, Inc. USA. Self-Aligning Ball Bearing. 1907. Chrome-plated steel, h. 1 3/4" (4.4 cm), diam. 8 1/2" (21.6 cm). Gift of the manufacturer

IMAGE FIFTEEN: American Steel & Wire Co., company design. American, est. 1898. American Steel & Wire Co. USA, est. 1898. Textile Spring. Before 1934. Steel, each: 9 1/4 x 2 1/4" (23.5 x 5.7 cm); beehive profile with integral loop at both ends. Gift of the manufacturer

IMAGE SIXTEEN: The Stanley Works. USA, est. 1843. Stanley-Bostitch. USA, 1896. Tinsmith's Hammer. Before 1940. Steel and wood, 12 x 4 3/8 x 1" (30.5 x 11.1 x 2.5 cm). Purchase

IMAGE SEVENTEEN: Aluminum Company of America, company design. USA, est. 1888. Aluminum Company of America. USA, 1907. Outboard Propeller. Before 1934. Aluminum, diam. 8" (20.3 cm). Gift of the manufacturer

IMAGE EIGHTEEN: Carl Elsener. Swiss, 1860–1918. Victorinox. Switzerland, 1897. Golden West Merchandisers, Inc. USA. Victorinox Swiss Officers' Knife Champion (no. 5012). 1968. Plastic and stainless steel, 3 5/8 x 1 x 1 1/8" (9.2 x 2.5 x 2.9 cm). Gift of Golden West Merchandisers, USA

INTRODUCTION

At the turn of the twentieth century, many people believed that art should be available to everyone and should reflect the industrial environment, embrace mass production, and clearly show structure and materials. Designers rejected excessive ornamentation and focused on reducing nature's organic forms to basic geometric shapes.

The Museum of Modern Art was founded in 1929 with the intent of "encouraging and developing the study of modern arts and the application of such arts to manufacture and practical life." Its 1934 exhibition of design objects, *Machine Art*, surprised the Museum's audience by including a three-story display of machine-made objects such as springs, laboratory appliances, tools, and furniture. The objects were placed on pedestals, just like sculptures.

In a 1946 article titled "What is Modern Industrial Design?" Edgar Kaufmann, Jr., a curator at the Museum of Modern Art, wrote,

> In modern design, each problem is considered to carry the germ of its own solution—full comprehension of the needs to be fulfilled will indicate the form of the design. . . . The responsibility of a modern designer thus becomes understanding his problem as thoroughly as he can and solving it as directly as he can. Modern designers do not wish to overcome conditions, they wish to meet them. Functions, materials, techniques, the environment and psychology of users—these are not to be circumvented or forced, they are guides to right design.[10]

This lesson introduces students to design objects in MoMA's collection that are also simple machines, many of which were included in *Machine Art*. It looks at how these innovative machine-made objects make people's lives easier.

LESSON OBJECTIVES

- **Students will be introduced to the "machine age" and to the history of The Museum of Modern Art's design collection.**

- **Students will learn to identify simple machines and will consider how they are used in daily life.**

- **Students will consider the various elements involved in creating innovative solutions to existing problems.**

INTRODUCTORY DISCUSSION

- **Ask your students what comes to mind when they think of machines. The word is derived from the Greek *mechane* and the Latin *machina*, which mean "an ingenious device or invention." What types of machines do your students encounter in their everyday lives?**

There are many different kinds of machines. This lesson will focus on simple machines, which are tools designed to make **work** easier.

- **Ask your students if they can list six different kinds of simple machines. Make a list of their answers on the board.**

10. Edgar Kaufmann, Jr. quoted in Antonelli, *Objects of Design*, 15.

The six simple machines are a **lever**, **inclined plane**, **wheel and axle**, **screw**, **wedge**, and **pulley**. For an exploration of simple machines, ask your students to visit these Web sites:

www.edheads.org/activities/simple-machines
www.coe.uh.edu/archive/science/science_lessons/scienceles1/finalhome.htm

Complex machines are made of several simple machines. For example, a tractor is a complex machine that is made of a wheel and axle and a pulley. A can opener is a machine composed of a lever, wheel and axle, and wedge.

- **Ask your students what simple or complex machines are most helpful to them in their daily lives. Why? Can they identify some of the parts of these machines? What simple machines are they made of?**

Inform your students that they will be looking at and analyzing some machines in MoMA's collection.

IMAGE-BASED DISCUSSION

- **Show your students the Self-Aligning Ball Bearing (Image Fourteen), by Sven Wingquist and SKF Industries, Inc. Ask them to describe what they see. What do they think this is used for? Why? What simple machine parts do they notice?**

Inform them that this is a self-aligning ball bearing. It is made of steel and is composed of two layers of balls in a "race," or track. A ball bearing is used to connect two machine parts so that there is a minimal amount of friction when they slide against one another. The smooth balls roll against a smooth metal surface, "bearing" the load and allowing the two machine parts to move against each other smoothly. For example, ball bearings are what allow inline skates to roll so well.

In 1907 the self-aligning ball bearing was a new design, offering better performance and greater efficiency than older sliding bearings (which did not have balls). The new design allowed the bearing to self-align so it could adjust to misalignment during functioning without disturbing its performance. Without this tool, machine parts would have to be replaced much more frequently.

- **Direct your students through the following experiment: Ask them to rub their hands together. What do they notice? They might notice heat, caused by friction. Then ask them to put a pencil or small ball between their palms and then rub them together. Does this change the amount of heat, or friction, they feel? This is a rudimentary way of explaining how a ball or rolling object can help reduce the amount of friction between two objects.**

- **Ask your students to consider what other objects use ball bearings. How do they help the object function better? Ask your students what they think of when they hear the term "machine age."**

The ball bearing is an emblem of the machine age, a period in the 1920s and 1930s in which designers were deeply interested in the look and style of machines, and in which good design was considered to be essential to the development of society. In 1934, this self-aligning ball bearing was one of the first design objects to enter MoMA's collection. It was selected for its aesthetic qualities and for its ability to improve machine functionality.

- **Show your students the Textile Spring (Image Fifteen), by American Steel & Wire Co. Ask them what they think this spring might be used for. What different kinds of springs can they list? They may come up with the springs in pens, eyeglasses, and mattresses, a Slinky toy, or the shock absorbers on a car or bicycle.**

This is a textile spring. A spring is an object that changes its shape in response to an outside force and returns to its original shape when the force is removed. Usually, the amount of the shape change is directly related to the amount of force exerted.

- **Ask a student to "spring" across the room. The student can coil up into a ball and then jump, forcing his or her body into a straight line, then repeat this action. What do the other students notice about this action? What does the student have to do with his or her body in order to spring?**

- **Ask your students to consider how a trampoline would be different if it did not utilize springs in its design. What do the springs enable a trampoline to do?**

MoMA has many different kinds of springs in its collection, including springs used for truck safety breaks, railroad cars, and bearings. The Slinky toy is also in MoMA's collection. It is a torsion spring, or a spring without tension.

- **Show your students the Tinsmith's Hammer (Image Sixteen), by the Stanley Works Company and Stanley-Bostitch. What do they notice? What materials is it made of? What might it be used for?**

- **Ask your students to imagine what it would be like to use this hammer. What actions can you perform with a hammer?**

- **Ask your students which of the six types of simple machines this could be.**

This hammer was designed by the Stanley Works Company, which was founded in 1843 by a Connecticut businessman named Frederick Trent Stanley to manufacture door bolts and other wrought-iron tools. It can be used either as a wedge, to drive things apart, or as a lever, to pound a surface or remove nails from wood. Today the company manufactures many different tools, including screwdrivers, planes, chisels, and flashlights.

This hammer was exhibited in a 1941 exhibition at MoMA titled *Useful Objects of American Design*. It was designed specifically for a tinsmith, a person who works with tinplate, a sheet of iron coated with tin and then run through rollers. Tinsmiths have been present in America since 1720. A tinsmith learned his trade by serving as an apprentice for four to six years. He first learned to fabricate cookie cutters and pill boxes, and then moved on to make more complicated objects, such as milk pails and cake pans. Later he would create things like chandeliers. A tinsmith only needed a few tools, because he typically formed simple shapes. He used large shears, hand scissors, an anvil, and a hammer.

- **Ask your students how this hammer is different from other hammers they have seen. What are the other hammers typically used for? How does the form of this hammer relate to its function of making tin objects?**

- **Next, show your students the Outboard Propeller (Image Seventeen), by the Aluminum Company of America. Ask them to make a list of words that describe this object. What might it be used for? What type of simple machine do they think it could be? Inform them that it is a type of screw. A screw is an inclined plane wrapped around a pole that narrows toward the top. An inclined plane is a surface set at an angle other than a right angle. A ramp, water slide, and funnel are examples of inclined planes.**

This screw is a propeller. A propeller is an object with two or more blades that propels an object through air or water when spun by an engine. This outboard is designed for use on a boat.

- **Ask your students to turn to the person next to them and discuss how they think propellers might move objects. How do they work? Have some of the pairs present their ideas.**

The blades produce force. As the screw turns, water is pushed down and back. Because every force has a reaction, water moves in to fill the space left by the downward-moving blade. This results in a difference in pressure between the top (pushing) and bottom (pulling) parts of the blade. If you have a household fan, you can demonstrate this principle—the fan pulls air from the back and pushes it out the front. A boat propeller pulls water from the front and pushes it out the back.

- **This propeller is made of aluminum. Ask your students what they know about aluminum. What objects in their everyday lives are made from this material? What are the properties of this metal? Why are sodas packaged in aluminum cans?**

When aluminum was first discovered, in the nineteenth century, it was as rare and as prized as gold. Due to improved manufacturing processes, it is now common and exists in a variety of forms, all of which have the quality of lightness. Aluminum has been used in objects as diverse as airplanes, canteens, chairs, trains, bathing suits, cookie sheets, bicycles, and walkers. It is both ductile and malleable, which means that it can be pulled into thin wire and rolled into foil. It can be cast into shapes and is an excellent conductor of heat and electricity. It is difficult to corrode and has a low melting point, which makes it easy to recycle. Its surface can also accept print, which makes it useful as a packaging device.

For a design object to be acquired by MoMA for its collection, it must be both beautiful and functional.

- **Ask your students if they agree that the self-aligning ball bearing, hammer, spring, and propeller should be in MoMA's collection. Why, or why not?**

- **Show your students the Victorinox Swiss Officers' Knife (Image Eighteen), by Carl Elsener, Victorinox, and Golden West Merchandisers, Inc. Ask them if they recognize this object. What are the different components they see? What are they used for? What kinds of simple machines can they recognize?**

The Swiss Officers' Knife is known in the United States as a Swiss Army knife. This multitool model weighs only 7.4 ounces and has sixteen blades and attachments that can perform twenty-nine functions. It is complicated to make: 450 different processes are used in its manufacture. It has a lifetime guarantee, but it works so well that only one in ten thousand are returned to the factory.

The first Swiss Officers' Knife was designed in 1897 in Switzerland to replace knives imported from Germany. To distinguish the knives from copies, designer Carl Elsener placed a white cross and shield on the outside. They became internationally known when American soldiers started using them during World War II. Because their Swiss name was difficult for Americans to pronounce, the soldiers called them Swiss Army Knives.

Two companies currently manufacture these knives. The original company, Victorinox, was founded in 1884 and manufactures over twenty-two million knives and pocket tools a year, in over one hundred different models. Each model is tailored for a different user, including designs named the Huntsman, the Electrician, the Executive, and the Motorist. The older knives contained a blade, can opener, toothpick, tweezers, corkscrew, Phillips-head screwdriver, and magnifying glass. Newer models can include a USB flash drive, digital clock or altimeter, LED light, laser pointer, and MP3 player.

- **Ask your students to work in pairs to discuss what kind of tools they would include if they were designing a Swiss Army Knife for themselves. What problems would they address? Ask them to sketch their multitools.**

ACTIVITIES

Geometric beauty

The Greek philosopher Plato (c. 424–348 BC) said,

> By beauty of shapes I do not mean, as most people would suppose, the beauty of living figures or of pictures, but, to make my point clear, I mean straight lines and circles, and shapes, plane or solid, made from them by lathe, ruler, and square. These are not, like other things, beautiful relatively, but always and absolutely.[11]

MoMA curator and architect Philip Johnson used Plato's philosophy in the 1930s to explain his inclusion of machine parts in museum exhibitions. This inclusion was shocking to many people, as a museum of modern art was a very new idea, and the fact that machines were exhibited in the same museum as paintings and sculptures was revolutionary.

Ask your students draw as many basic shapes as they can, using markers or colored pencils. Then have them combine some of these shapes to create a drawing. Ask them to consider the composition of their drawings. When they have finished, lead the class in a critique. Each student should present his or her idea and then the class can discuss the work and ask the artist questions.

Tools

Ask your students to identify a problem they encounter in their everyday lives and design a tool to solve it. Their tool could be a simple machine or a combination of some of the six types of simple machines. Have them name their tool, create a sketch, list the materials, and write instructions for how to use it. Then have them present their ideas.

11. Plato, *Philebus* 51 c.

LESSON FOUR: Exploring the Design Process: The Work of Charles and Ray Eames

IMAGE NINETEEN: Charles Eames. American, 1907–1978. Evans Products Co., Molded Plywood Div., Venice, Calif. Leg Splint. 1942. Molded plywood, 4 1/4 x 7 3/4 x 42" (10.8 x 19.7 x 106.7 cm). Gift of the manufacturer

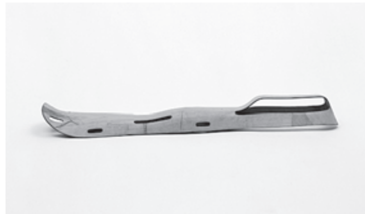


IMAGE TWENTY: Charles Eames. American, 1907–1978. Evans Products Co., Molded Plywood Div., Venice, Calif. Leg Splint. 1942. Molded plywood, 4 1/4 x 7 3/4 x 42" (10.8 x 19.7 x 106.7 cm). Gift of the manufacturer

IMAGE TWENTY-ONE: Charles Eames. American, 1907–1978. Evans Products Co., Molded Plywood Div., Venice, Calif. Side Chair (model DCW). 1946. Molded and bent birch plywood and rubber shock-mounts, 29 1/2 x 19 x 21 1/2" (74.9 x 48.3 x 54.6 cm). Gift of the manufacturer

IMAGE TWENTY-TWO: Charles Eames. American, 1907–1978. Evans Products Co., Molded Plywood Div., Venice, Calif. Side Chair (model DCW). 1946. Molded and bent birch plywood and rubber shockmounts, 29 1/2 x 19 x 21 1/2" (74.9 x 48.3 x 54.6 cm). Gift of the manufacturer

IMAGE TWENTY-THREE: Charles Eames. American, 1907–1978. Evans Products Co., Molded Plywood Div., Venice, Calif. Herman Miller Furniture Co., Zeeland, Mich. Folding Screen. 1946. Molded calico ash plywood and canvas, h. 68" (172.7 cm); six 9 1/2"-wide (24.1 cm) U-shaped sections, joined by a full-length canvas hinge, sandwiched into plywood laminations. Gift of Herman Miller Furniture Co.

IMAGE TWENTY-FOUR: Charles Eames. American, 1907–1978. Evans Products Co., Molded Plywood Div., Venice, Calif. Herman Miller Furniture Co., Zeeland, Mich. Folding Screen. 1946. Molded calico ash plywood and canvas, h. 68" (172.7 cm); six 9 1/2"-wide (24.1 cm) U-shaped sections, joined by a full-length canvas hinge, sandwiched into plywood laminations. Gift of Herman Miller Furniture Co.

INTRODUCTION

Charles Eames, trained as an architect, and Ray Kaiser, trained as a painter, met in 1940 at the Cranbrook Academy of Art, in Bloomfield, Michigan. They married, and over the course of their life together, these creative visionaries designed furniture, films, exhibitions, toys, graphics, and interiors. In addition to their design work, they served as ambassadors and consultants to businesses and governments (nationally and internationally) about the role and impact of design in modern life. Charles and Ray's interests and curiosities went far beyond their Southern California design office. They traveled the world documenting people, places, and things, amassing more than 800,000 photographs. Inspired by the beauty of everyday objects, they photographed such diverse items as an overflowing pile of colorful buttons in an Indian market and a shiny plastic typewriter keyboard. Central to their work was the idea that design was primarily about process, not a final product or outcome. They applied this philosophy to all their projects, often revisiting ideas and refining them over time. The Eameses believed strongly that good design should be affordable. Working in post–World War II America, they used new manufacturing technologies combined with low-cost materials to ensure that good design could be accessible to all. Their iconic chairs are some of the most widely copied design objects of our time. This lesson explores the Eameses' design philosophy as it was applied to three types of objects.

LESSON OBJECTIVES

- **Students will explore the process of design as it is applied to three different types of objects.**
- **Students will learn about the design and production of chairs designed by Charles and Ray Eames.**
- **Students will consider the ways designers visit and revisit ideas to achieve a desired outcome.**

INTRODUCTORY DISCUSSION

Need and the Guest/Host Relationship

In his book *An Eames Primer*, Eames Demetrios (grandson of Charles Eames) identifies a core component of the Eames design process:

> One of the most powerful forces in the Eameses' work, a force that can be identified in virtually every major project the Eameses undertook, is the guest/host relationship. Charles felt that that this was one of the most basic, even primal, human relationships. Every society in the world valued this relationship—it existed in a nomad's tent and a raja's court. He also believed that this relationship was important in design. He often suggested that one a major question about the modern city is, If we are all guests "then who are the hosts?"[12]

- **Ask your students to consider what the Eameses meant by "the guest/host relationship"? How does your students' understanding of this idea relate to their everyday lives? In what areas of their lives are they guests?**

The Eameses felt that designers create an experience, not just an object. Design, they felt, hosts the user, or guest. The recognition of need was central to their process. Different than want, need is a more urgent guiding principle in the design process.

- **Lead a discussion with your students about need versus want. Once you come to a common definition of terms, have your students identify five needs and five wants they have in their lives. Ask your students to then consider how design could address the needs and wants they have identified.**

12. Eames Demetrios, *An Eames Primer* (New York: Universe Publishing, 2001), 155.

IMAGE-BASED DISCUSSION

- **Show your students Leg Splint (Images Nineteen and Twenty), by Charles Eames, for a few moments, but do not tell them what it is called. Explain to them that they are looking at views of the same object from different perspectives: from above (bird's-eye view) and from the side.**

- **Ask your students to describe the object they see. How does the object seem to change as they observe it from different points of view? Ask them to consider what this object might have been used for. It may be useful at this point to tell your students that it is approximately seven inches long and four inches wide.**

In the early 1940s, the Eameses experimented with molding plywood into different forms. Some of the forms were sculptures and others were experiments for chair design. The designers hoped to achieve complex curves for chairs that would closely echo the human form, thus serving the needs of the human body. No other designers were working with plywood in exactly this way.

- **Ask your students if they see any ideological correlation between the guest/host relationship and the Eameses' experiments with molding plywood.**

In 1944, when United States entered World War II, most design projects were directed towards the war effort. Dr. Wendell Scott, a friend of Charles Eames, sought his help in designing a leg splint for injured soldiers. The metal splints in use were made of a material that created vibration, causing pain and further injuring the wounded soldier. The Eameses had been working with bending and molding plywood, and so they were asked to take on the problem and come up with an alternate design. They developed a splint that conformed to the shape of the leg, naturally preventing strain and pain. The splint was placed behind the injured leg, with the foot resting in the deepest part of the splint. The negative spaces were used to secure the leg to the splint. The splint worked well and also could be manufactured with minimal materials, thus decreasing costs at a time when resources were scarce.

- **Ask your students to look at the object again with this new information in mind. Ask them to consider both the functional and aesthetic aspects of this design.**

- **Next show your students the Side Chair (model DCW) (Images Twenty-one and Twenty-two), by Charles Eames. Have them describe the object as represented in both views. See if your students, by looking closely at it, can deduce how this object was made.**

The pieces of this chair were made by layering and gluing thin sheets of wood together, then pressing them together in a machine using heat. Plies (the thin planes of wood) were added and pressed together until the desired thickness was achieved.

- **Ask your students to look closely at the images of the chair to see if they can identify its different parts. How are these separate components attached to one another?**

When the Eameses first began applying this material and process to the design of chairs, they hoped to create one unified form. However, production techniques at the time would not allow for a single form with complex curves that was also strong enough to withstand the wear and tear of everyday use. Instead, they created a series of curved forms that could be joined to each other. This early molded-plywood chair employs flexible rubber disks at connection points. The flexibility of the disks makes the chairs comfortable, but they deteriorate and loosen quickly. This design element was revisited and refined over time. Images of later-model Eames plywood chairs can be seen on the Museum's Web site, at www.moma.org/collection.

- **Tell your students the dimensions of this chair. Ask them to imagine what it would be like to sit in it. In what kind of environment do they imagine this chair? In what environment might one want to have a chair that is situated low to the ground?**

- **Next, show your students the Folding Screen (Images Twenty-three and Twenty-four), by Charles Eames. Give each student two pieces of paper and ask them to re-create the shapes they see with the paper. Once they have made their paper sculptures, ask them to stand their works upright. If they need to re-form them or use an additional piece of paper they should do so. Give your students ample time to complete this task. Afterward, ask your students to reflect on the process in written or verbal form. What was hard about it? What was easy? How did they need to manipulate the paper in order to make it stand up?**

In early explorations of molding plywood, many unintended shapes were created. In some cases, these shapes were later used in the design of an object. For example, after spending some time analyzing U-shaped cross sections of plywood, the Eameses determined that with the addition of flexible connectors they could be combined or folded together to create a screen. The stability of the plywood allowed the screen to be positioned in different ways, either fully or partially open, to create multiple shapes. Through trial and error, the designers settled on canvas and glue for the hinges between the U-shaped sections.[13]

- **Ask your students to look at the images of the screen and identify its parts. Then have them experiment with their paper sculptures, altering and changing the folds to create different forms.**

- **Have your students look at the three objects discussed in this lesson. Have them revisit the ideas and concepts discussed, with their new information about the design process. Ask them to consider the process of design for each individual object. Ask your students to consider why the Eameses would revisit an idea several times. How are the objects similar? Do they remind your students of things they have seen in the built or natural environment? Ask your students to be specific about the relationship between the form and the function of these objects.**

ACTIVITIES

Modeling Forms

Have your students create sketches of different forms they find interesting. Once they have created multiple drawings, have them select one to render in three dimensions using clay or another type of modeling material. When they have created their models, have them consider how these forms could be applied to a design object. What factors would have to be considered in applying these forms to functional objects? What manufacturing materials would best serve their design concepts? Would their objects be created by hand or by machine?

House of Cards

In 1952 Charles and Ray Eames created a game for kids. Pulling images from their library and that of textile designer Alexander Girard, they created two different decks of cards that can be interlocked to create three-dimensional structures. Depending on which face of the card is exposed, the structures juxtapose images from buttons to South American dolls to textiles. This game, designed to highlight the beauty in the everyday, is still in production today.

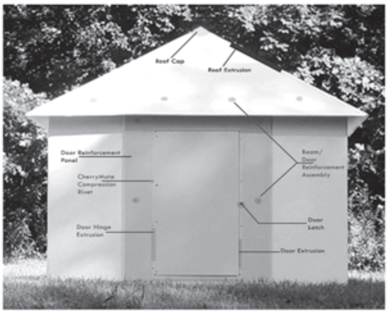
13. John Neuhart, *Eames Design* (New York: Harry N. Abrams, 1989), 79.

Work with your students to create your own images for a house of cards game. Tag board, oak tag, or card stock can be used to create a template for the cards. Have your students determine the size and scale of the cards and then determine what imagery they will include.

India Report

In 1958 Charles and Ray Eames were invited by Prime Minister Jawaharlal Nehru to visit India to observe and immerse themselves in the culture, then advise him how to address the low quality of consumer goods in India. After completing six months of travel and research in India, the Eameses coauthored a report on their findings. This document was the foundation for the establishment of the National Institute of Design (NID) in Ahmedabad, India. The mission of this organization, which still exists, is to offer design consultancy services, advocate for the design community, and provide a resource for education and mentoring. Have your students review the Eameses' report on the NID Web site, at www.nid.edu/aboutus_main.htm, and discuss the ideas proposed. Are these ideas from 1958 relevant to present-day India? How has the NID incorporated these suggestions? Have your students conduct similar research for the United States and suggest ways that the USA could boost consumer product production.

LESSON FIVE: Design That Makes a Difference: Focus on Shelters and Water



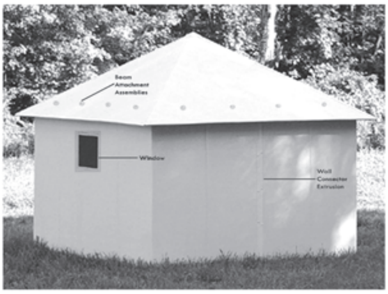


IMAGE TWENTY-FIVE: Daniel Ferrara. American, born 1941. Mia Ferrara. American, born 1977. Ferrara Design, Inc. USA, est. 1968. Global Village Shelters, LLC, USA. in partnership with Weyerhaeuser, USA. Global Village Shelter. 2001. Triple-wall fiberboard corrugate, 7' 5" x 8' 2 1/2" x 8' 2 1/2" (234 x 250 x 250 cm). Gift of Global Village Shelters, LLC

IMAGE TWENTY-SIX: Michael Rakowitz. American, born 1973. paraSITE Homeless Shelter. 1997. Polyethylene, 42" x 36" x 11' (107 x 91.5 x 335 cm). Gift of Michael Rakowitz and Lombard-Freid Projects

IMAGE TWENTY-SEVEN: Nikhil Garde. Danish, born 1972. Designskolen Kolding. Denmark, est. 1967. Instructors: Elle-Mie Ejdrup Hansen. Danish, born 1958. Barnabas Wetton. British, born 1962. Michael Frederiksen. Danish, born 1966. Viking Life-Saving Equipment A/S. Denmark, est. 1960. Sea Shelter. 2004. Nylon and rubber, 6' 6 3/4" x 10' 6" x 12' 1 5/8" (200 x 320 x 370 cm). Alexander Schärer Purchase Fund

IMAGE TWENTY-EIGHT: UNICEF United Nations Children's Fund. Est. 1946. Multiple manufacturers. Water Container. n.d. PVC-coated polyester, polyethylene, or equivalent materials; collapsible, capacity five gallons (twenty liters). Gift of United Nations Children's Fund

IMAGE TWENTY-NINE: Stephan Augustin. German, born 1967. Wisser Verpackungen GmbH (Germany). Watercone Water-Collection Device. 1999. Makrolon polycarbonate, diam. 11 3/4 x 31 1/2" (30 x 80 cm). Gift of Augustin Produktentwicklung

IMAGE THIRTY: Niels Due Jensen. Danish, born 1943. Grundfos Management A/S. Denmark, 1945. SQFlex Combo Drinking Water Pump. 2001. Stainless steel, aluminum, fiberglass, polycrystalline silicone, and polymer; pump: diam. 48 x 2 7/8" (122 x 7.3 cm); wind turbine: diam. 10' (304 cm); solar panel: 48 x 21" (122 x 53.3 cm); control box: 9 x 7 x 3.5" (22.8 x 17.7 x 8.9 cm). Gift of Grundfos Pumps Corporation

INTRODUCTION

One in seven people worldwide lives in a slum or refugee camp, and more than three billion people, or nearly half of the world's population, do not have adequate sanitation or access to clean water.[14] This lesson will focus on how designers respond to severe environmental conditions to alleviate human hardship. It examines three different types of temporary shelters and discusses how designers have responded to specific environmental factors. It then presents three innovative designs that help people access, filter, and carry water.

LESSON OBJECTIVES

- **Students will look at how designers address specific problems, such as the need for temporary housing and clean water, and consider various solutions to these problems. Students will consider the use and cost of materials in design.**

- **Students will think about how environmental factors can affect design.**

INTRODUCTORY DISCUSSION

- **Ask your students to define "shelter." A shelter is a basic structure that provides protection from the sun, wind, and cold. What different kinds of shelters can they list? What are the different components of a shelter? How do shelters differ around the world? How do factors like climate affect the design of shelters?**

- **Ask students to discuss their homes in small groups. What elements are similar? What are different? How are their homes designed for the environment in which they are located? How do they provide protection from weather conditions? What materials are they made of? When were they built? Ask each group to present its findings to the rest of the class.**

People who have been displaced from their homes by natural or man-made disasters often need quick housing solutions.

- **Ask your students to research recent environmental disasters such as Hurricane Katrina in 2005 and the tsunami in the Indian Ocean in 2004. What happened? Why were people displaced? What solutions did governments attempt? How well did they work? Have your students discuss their research with the class.**

Designers have created temporary shelters that may be used in emergency situations. These need to be inexpensive, portable, and easy to set up, and must provide protection from the elements. In this lesson, we will look at shelters addressing diverse environmental needs. We will also look at three objects that help to supply people with clean water.

IMAGE-BASED DISCUSSION

- **Show your students Global Village Shelter (Image Twenty-five), by Daniel Ferrara and Mia Ferrara of Ferrara Design, Inc., and Global Village Shelters, LLC. Ask them what they can learn about this shelter just by looking at it. What do they notice about its size? Material? What purpose might it serve?**

This shelter was designed in 2001 by the American father-daughter team Daniel and Mia Ferrara. After testing over one hundred different configurations, they designed this wind- and fire-resistant house. Made of recycled corrugated cardboard, it can be assembled in less than an hour and lasts up to a year. It has easy-to-follow instructions, can be packed flat, is easy to ship, and costs around four hundred dollars. The door has a lock for security purposes.

14. Architecture for Humanity, ed. *Design Like you Give a Damn: Architectural Responses to Humanitarian Crises* (New York: Metropolis Books, 2006), 52.

In Granada in 2005, Hurricane Ivan destroyed eighty-five percent of housing stock. Makeshift schools and clinics were built under tarps, and temporary homes were built with debris. To help address the housing shortage, seventy Global Village Shelters were shipped to Granada to be used as clinics and temporary houses. These shelters can also be linked together to form a larger structure. The designers are currently developing a permanent structure that would include a toilet.

- **Ask your students to summarize the factors that make the Global Village Shelter a good design. How do the form, materials, cost, and assembly process contribute to the function?**

- **Show your students the paraSITE Homeless Shelter (Image Twenty-six), by Michael Rakowitz, but do not tell them what it is called. Ask them to make a word list describing the things they notice about the structure. Have them each share one word, and ask them to try not to repeat any words.**

- **Ask your students what kind of shelter they think this is. What problem might it solve? What materials do they see? How are the materials used?**

- **Tell your students the structure's title. What does this title tell them about it? Ask them to discuss how the word "parasite" relates to this object.**

The designer, Michael Rakowitz, says that parasitism is "a relationship in which a parasite temporarily or permanently exploits the energy of a host."[15] This shelter, which is designed for use by homeless people, is small, collapsible, temporary, and easy to transport. It uses the outside of a building's HVAC (heating, ventilation, and air-conditioning) system to give it form and for a source of heat.

In 1997 Rakowitz proposed the concept and a prototype of this shelter to Bill Stone, a homeless man living in Cambridge, Massachusetts. At the time, city officials were installing tilted grates over HVAC vents in Harvard Square so that homeless people could not sleep on them. According to Stone, the paraSITE shelter is a tactical response to the challenges presented by the city.

This shelter was originally constructed of materials easily found on the street, such as plastic bags and tape. Now it is made of polyethylene, a type of plastic (for an in-depth exploration of plastics, see Lesson Six). It costs about five dollars to make and is provided to users free of charge.

Rakowitz says, "Many of the homeless users regarded their shelters as a protest device, and would even shout slogans like, 'We beat you, Uncle Sam!' The shelters communicated a refusal to surrender, and made more visible the unacceptable circumstances of homeless life within the city."[16] The paraSITE shelter is meant to be a temporary solution and to act as a form of social protest. It has been controversial in cities where it has been used, as it makes the problem of homelessness visible to all who pass by.

- **According to a report by the National Alliance to End Homelessness, between 150,000 and 200,000 people in the United States are chronically homeless.[17] Have your students research homelessness in their area. What are some existing solutions? What others can they think of?**

15. Michael Rakowitz, "paraSITE," www.michaelrakowitz.com.
16. Ibid.
17. National Alliance to End Homelessness, "Chronic Homelessness Brief" (PDF), March 2007, http://www.endhomelessness.org/content/article/detail/1060.

- **Show your students Sea Shelter (Image Twenty-seven), by Nikhil Garde and the design school Designskolen Kolding, but do not tell them what it is called. Ask them to describe what they see. What do they think this shelter might be used for? Inform them that it is called Sea Shelter. A combination life raft and seaworthy tent, it was Garde's project in graduate school; he worked with the maritime safety company Viking Life-Saving Equipment.**

- **Ask your students to imagine climbing aboard a life raft in the middle of the ocean during a storm. What are some of the environmental challenges they might face?**

To address some of these challenges, this raft has to be flexible, lightweight, easy to launch, and self-righting. It also has to be easy to climb. The Sea Shelter has handles and a step that extends under the water. It is designed to position itself according to the direction of the wind and waves so that it floats with the current, making the ride more comfortable.

- **Ask your students to compare this shelter to the previous two. How do they solve temporary housing problems? How are the materials similar? Different? What environmental factors do each of these design solutions address?**

- **In addition to shelter, what are other basic human needs? Make a list on the board. You may want to discuss Abraham Maslow's Hierarchy of Needs with your students. (For more infor-mation about this, please visit http://chiron.valdosta.edu/whuitt/col/regsys/maslow.html.)**

Now that you and your students have looked at various types of shelters, we are going to move onto another major issue facing people in developing nations—water and sanitation.

- **Ask your students what the role of water is in their daily lives. How do they obtain water? What do they use it for?**

- **Ask your students to imagine carrying, from a source miles away, all the water they drink, bathe in, and wash their hands with in one day. Have your students consult a map. What would their source for water be? How far is it from their house? Is the water clean? How long would it take to walk back and forth from this site? Have them research which reservoir supplies water to their city or neighborhood. Where does the water come from?**

Many people around the world lack access to clean water, and three billion are without proper sanitation facilities. More than two million people die each year from preventable water- and sanitation-related diseases.[18] The next three objects address these issues.

- **Show your students Water Container (Image Twenty-eight), but do not tell them what it is called. Ask them what they think it might be used for. Inform them that this is a water container used by the United Nations Children's Fund (UNICEF).**

- **Ask your students to do a quick Internet search for more information about UNICEF. What is the mission of this organization? When was it founded? Whom does it serve? Have them discuss their findings in class.**

Founded in 1946, UNICEF aids children around the world by providing services ranging from basic necessities like food and clothing to education and housing. The organization educates people about water sanitation and distributes this water container to help combat water-borne diseases. It has built-in safeguards that prevent the water from being touched by people's hands, thus preventing contamination. It is also lightweight, collapsible, and easy to stack, making it easy to transport.

18. Architecture for Humanity, 278.

- **Show your students the Watercone Water-collection Device (Image Twenty-nine), by Stephan Augustin and Wisser Verpackungen GmbH, but do not tell them what it is called. Ask them what they think this object might be used for. Why?**

Inform them that this is a water collection and purification device called Watercone. It is a solar water purifier that uses the sun's heat to evaporate water. The water evaporates and then condenses on the inside of the cone. If you flip the cone over, you can pour the water directly into a container. This is a cheap and durable system that can purify about 1.5 liters of water a day, enough for one child. Two Watercones can take care of one adult. The device kills all waterborne pathogens and removes particulates, many chemicals, and heavy metals. It can also desalinate seawater, which is an important function for people who live near the ocean and lack fresh water. Because it is stackable, it is easy and inexpensive to ship.

- **Ask your students to research other water purifiers. How do they work? What materials do they use? What is their cost? How does their design contribute to their function? Ask students to make a chart rating their findings. If they were to purchase a water purifier, which one would they select? Why?**

- **Show your students the SQFlex Combo Drinking Water Pump (Image Thirty), by Niels Due Jensen and Grundfos Management A/S. Inform them that this is a water pump. How do they think it might work? Have them identify the two main parts shown in the image. What do they think they might be used for? Have they ever seen a wind turbine before?**

This water pump was designed for use in remote areas. Advances in technology have enabled people to go to areas in the world previously considered uninhabitable.

- **Ask your students to imagine they are in the middle of the desert. What kinds of things would be around them?**

This water pump uses two natural elements that are readily available and produce energy—the sun and wind—and can be attached to existing pump systems.

The Danish company that manufactures these pumps, Grundfos, is dedicated to environmental responsibility. Its founder, Niels Due Jensen, said, "When this generation delivers planet earth to the next generation, it should be a cleaner and more energizing place than the place which we inherited."[19]

- **Ask your students to summarize what they have learned about water purifiers, pumps, and containers. What problems do each of the objects discussed in this lesson solve?**

- **Ask your students to work in groups to create an idea for their own environmentally responsible company. What will they produce? What will they do that is good for the environment? What considerations would they have to take into account when creating their products?**

ACTIVITIES

Create Your Own Shelter

Ask your students to work in small design teams to create their own temporary shelter. Have them think about what specific problem they want to address. They should consider materials, size, assembly, and environmental conditions. Ask them to create a drawing and to present it, along with their rationale, to the class.

19. Niels Due Jensen, quoted in "Social responsibility: The challenge of making your employees comply," by Thor Wilkens, Well Web, www.wellweb.org/Default.asp?Id=108&AjrNws=102&AjrNwsPg=1 (accessed March 2008).

Architecture for Humanity

Architecture for Humanity is a nonprofit organization that encourages architects and designers from all over the world to think creatively about how to solve problems in their community. It helped the government of Granada link up with the designers of the Global Village Shelter to facilitate the distribution of seventy shelters. Ask your students to visit the organization's Web site, at www.architectureforhumanity.org, select a project they find interesting, and present their findings to the class or to small groups.

Action!

Ask your students to research other objects that help people in developing countries obtain or transport water. The Hippo Water Roller (www.hipporoller.org), the Roundabout Outdoor PlayPump (www.playpumps.org), and a ceramic water filter (www.potpaz.org) are some examples.

Ask your students to select one of these objects and hold a fundraiser to raise money for its purchase. Why did they select that object? How much money will they need to raise to meet their goal? Who will it help? Why will it be effective?

LESSON SIX: Materials and Process: Plastics

IMAGE THIRTY-ONE: W. Grancel Fitz. American, 1894–1963. *Cellophane.* 1928 or 1929. Gelatin silver print, 9 3/16 x 7 9/16" (23.3 x 19.3 cm). John Parkinson III Fund

IMAGE THIRTY-TWO: Jonathan De Pas. Italian, 1932–1991. Donato D'Urbino. Italian, born 1935. Paolo Lomazzi. Italian, born 1936. Blow Inflatable Armchair. 1967. PVC plastic, inflated: 33 x 47 1/8 x 40 1/4" (83.8 x 119.7 x 102.9 cm). Manufactured by Zanotta SpA, Italy. Gift of the manufacturer

IMAGE THIRTY-THREE: Earl S. Tupper. American, 1907–1983. Tupper Corporation USA. Pitcher and Creamer. 1946. Polyethylene, .1 (pitcher): 6 1/2 x 6 5/8 x 4 3/4" (16.5 x 16.8 x 12.1 cm), .2 (creamer): 4 1/4 x 4 1/4 x 3 3/16" (10.8 x 10.8 x 8.1 cm). Gift of the manufacturer

IMAGE THIRTY-FOUR: Arthur Young. American, 1905–1995. Bell-47D1 Helicopter. 1945. Aluminum, steel, and acrylic plastic, 9' 2 3/4" x 7' 11" x 42' 8 3/4" (281.3 x 302 x 1271.9 cm). Manufactured by Bell Helicopter, Inc., Buffalo, N.Y. Marshall Cogan Purchase Fund

IMAGE THIRTY-FIVE: Panasonic. Japan, est. 1918. Toot-A-Loop Radio (model R-72). c. 1972. ABS plastic, h. 2 3/4" (7 cm), diam. 6" (15.2 cm). Manufactured by Panasonic Company, Secaucus, N.J. Gift of Anne Dixon

IMAGE THIRTY-SIX: Panasonic. Japan, est. 1918. Toot-A-Loop Radio (model R-72). c. 1972. ABS plastic, h. 2 3/4" (7 cm), diam. 6" (15.2 cm). Manufactured by Panasonic Company, Secaucus, N.J. Gift of Anne Dixon

IMAGE THIRTY-SEVEN: Apple Computer, Inc. USA, est. 1976. Apple Industrial Design Group. USA. Jonathan Ive. British, born 1967. iPod. 2001. Polycarbonate plastic and stainless steel, 4 x 2 1/2 x 7/8" (10.2 x 6.4 x 2.2 cm). Manufactured by Apple Computer, Inc., Cupertino, Calif. Gift of the manufacturer

INTRODUCTION

"Plastic" is a general term for a wide range of synthetic and naturally occurring polymers. The word is used to describe something that can be molded or re-formed. The term "polymer" is derived from a Greek word meaning "many"; most plastic objects incorporate materials with the prefix "poly," a short way of saying polymer. A polymer is a giant molecule, or macromolecule, that consists of many smaller, repeating chemical building blocks. Different building blocks create different kinds of plastic, each of which has its own unique properties and applications. It is a common misconception that all polymers are synthetic: Some polymers occur in nature (called biopolymers) and play a significant role in the life processes of plants and animals. For example, starches (polysaccharides) are important energy sources for plants and animals, and cellulose (a different type of polysaccharide) gives plants structure. The raw materials used to make polymers come from the earth (petroleum and coal, for example) or plant matter. They also come from old plastics, which is the basis for the plastics recycling industry.

LESSON OBJECTIVES

- **Students will learn about the development of plastics in the twentieth century.**
- **Students will learn different techniques for manufacturing and casting plastics.**
- **Students will learn about the different applications of plastics in industrial design.**
- **Student will learn new vocabulary, including "polymer," "plasticity," and plasticizers.**
- **Students will learn about the impact of plastics on modern life.**

INTRODUCTION

Polymer chemistry developed over the course of the nineteenth and twentieth centuries. The new materials that resulted, called plastics, can be combined and formed into films, fibers, and objects through chemical and mechanical processes such as extrusion, blow molding, and injection. The development of plastics made it possible to create lighter, more durable, and more affordable consumer products. Today's plastics are not only sturdy and resilient but, in some cases, beautiful. This lesson will explore the impact of plastics on modern design.

INTRODUCTORY DISCUSSION

Divide your class into teams of two to four students. Give each team five minutes to explore a specific area of the classroom, looking for objects and spaces made primarily of plastics. Have them keep track of their findings, providing brief descriptions of the object or space and what it is used for. Have your students come together to share their findings. Ask them to describe one or two of the objects they selected. What do they look like? What is their function? What is it like to touch them? Are they heavy or light? Do they feel hard or soft? Ask your students to consider what the objects would look like or how they would function if they were made out of another type of material, such as metal or wood.

IMAGE-BASED DISCUSSION

Show your students *Cellophane* (Image Thirty-one), by W. Grancel Fitz, but do not tell them what it is called. Ask them to describe what they see in the image, then share the title with your students. This is an image of a woman looking at a piece of cellophane. Cellophane is a thin transparent sheet of film made from a naturally occurring polymer called cellulose, found in trees and plants. A Swiss textile engineer invented cellophane in 1908. One of its earliest uses was wrapping food. Whitman's Candies' boxes were wrapped in cellophane, and the company was one of the largest users of cellophane in the early twentieth century.

- **Ask your students why the Whitman's Candies company might have chosen cellophane to wrap their candy boxes instead of some other kind of wrapping material.**

Cellophane is made by converting cellulose fibers to cellulose xanthate. This viscous liquid is forced through a slit-shaped die (a device for forming material), after which it coagulates back into pure cellulose to produce a solid film. The resulting material is transparent and lightweight, yet strong, and can be used in many different applications. Another material derived from cellulose is viscose, or rayon. Rayon continues to be an important fiber in the textile and apparel industry. In 1924 the Dupont Company built the first cellophane manufacturing plant in the United States. Before that, manufacturers in the United States imported the material from Europe. Cellophane continues to be a significant food packaging material and is one hundred percent biodegradable.

Have your students read the labels in some of the garments they own to see if any of them contain rayon fiber.

- **Next show your students the Blow Inflatable Armchair (Image Thirty-two), by Jonathan De Pas, Donato D'Urbino, and Paolo Lomazzi, but do not tell them what it is called. Ask them to describe the way the object looks and have them guess what material it might be made of. Have them describe what it might be like to sit in a chair like this.**

The Blow Inflatable Armchair was designed in 1967. It is made out of polyvinylchloride, or PVC. Write this word on the board for your students. Do they recognize any part of the word? Next, draw a line between the letters y and v, and between l and c. This breaks the word into three parts: poly-vinyl-chloride. Vinyl is another type of plastic film.

- **Ask your students if they know of any other items made of vinyl.**

Vinyl can be found in furniture upholstery, plastic pipes, and music records. PVC is low cost, durable, and easy to manipulate. By itself, PVC is a hard inflexible material, but it can be softened by adding plasticizers. Plastic pipes and music records are made of unplasticized PVC. When it is in a softer, more **pliable** state, it can be used to form objects like the Blow Inflatable Armchair.

- **Ask your students whether this chair would feel hard or soft to touch. Have them support their assertions with information gathered during their object observation. Tell your students the title of this chair. Does this information help answer the question?**

This is an inflatable chair, which means that air pumped into the PVC skin gives it its form. Without the air, this chair would be like a large, empty balloon. In its deflated state, the vinyl of the chair feels soft and pliable. In a fully inflated state, it feels harder and stiffer.

Once again, have your students try to imagine what it would be like to sit in this chair. Would it be comfortable? Why, or why not? Why would someone need or want an inflatable chair? What are the advantages? Why would a designer choose this particular form and material for this object?

- **Next show your students the Tupperware Pitcher and Creamer (Image Thirty-three), by Earl S. Tupper and Tupper Corporation, but do not tell them what they are called. Have them describe what they see with particular attention to each object's shape, form, scale, color, and material. Give your students the dimension of each of the objects. Ask your students to consider what these objects might be used for.**

Tell your students that they are looking at a pitcher and creamer designed by Earl S. Tupper for the Tupper Corporation in 1946. These two objects are both made out of injection-molded polyethylene. Polyethylene (PE) is the simplest form of plastic. It is a thermoplastic, which means that, to form objects, the plastic is heated and melted then injected into a mold under high pressure. After the material has cooled, the mold is opened and the object is removed.

- **Explain this process to your students and ask them what factors might have to be considered when producing an object in this way. Is there anything about the way these objects look that tells the story of how they were made?**

Although injection molding seems simple, the construction of the tools and molds, the consistency and flow of the molten plastic, and the objects' cooling times must all be precisely handled to achieve the desired outcome. For example, temperature must be strictly controlled: If the plastic is injected into the mold at too high a temperature, it will decompose; and the object may warp when it is removed from the mold if it has cooled down too fast. Tupper was the first to bring this process to the design and manufacture of plastic household items such as food containers, mugs, and the pitcher and creamer featured in this lesson. Once he had designed their forms to his desired specifications, he developed a patented Tupper Seal (modeled after a paint can) for each container. Tupper Seals enabled users to tightly close the containers to preserve the freshness of the food inside. Tupper expanded on this design, and Tupperware semi-opaque, stackable food containers became synonymous with 1950s American lifestyle. Through his work, Tupper hoped to make "woman's life" easier.[20]

- **Ask your students to consider why Tupper felt that these new objects could make women's lives easier. What is it about the way the objects look or function that would make life easier?**

Tupperware is a light, efficient, affordable, and aesthetically pleasing way to store and preserve food and other household items. Prior to Tupperware, all food storage containers were made out of glass and could not be firmly sealed shut. The company is in business today with an expanded line of household products.

- **Ask your students to imagine what it would be like if these everyday objects were made of glass. Would life be more difficult? If so, why?**

Next show your students the Bell-47D1 Helicopter (Image Thirty-four), and draw their attention to the cockpit of the helicopter. Have your students describe this part of the helicopter. Ask your students to think about the types of activities that take place in the cockpit of a helicopter. What does a pilot need to be able to do to operate a helicopter properly and efficiently?

This helicopter was designed and produced in 1945. What set it apart from other helicopters of its time was the acrylic plastic blow-molded cockpit. Blow molding is a process by which hollow plastic parts are formed from a single sheet of polymer film. The film is heated above its softening point and then pressed against a mold by a blast of compressed air. Through this process, the cockpit shell of this helicopter was made from one piece of acrylic plastic

20. Earl S. Tupper, quoted in *Objects of Design*, 104.

rather than sections joined by metal seams. The result is a lighter shell with a more unified appearance. The Bell-47D1 Helicopter was used widely during the Korean War as an aerial ambulance. Like Tupperware, its design was revolutionary in its time.

- **Ask your students to think about objects they would consider revolutionary in current times. Have them cite specific examples of objects whose form or function makes them stand out from other objects that perform a similar function. What kinds of materials are used in the production of these objects?**

Organize your students into pairs. Assign one student to be the "drawer" and the other to be the "describer." Give pencils and paper to the drawers and give the describers the image of the Toot-A-Loop Radio (model R-72) (Image Thirty-five), by Panasonic. Then, ask the describers to explain what they see. The drawers should draw what they hear being described, without ever seeing the image, and the describers should limit their comments to descriptions of the image—they must not comment on the drawing that is being created. Various additional rules can be applied to this exercise. For instance, the drawer may be prohibited from asking the describer any questions, or the describer may not be allowed to see what the drawer is drawing. Decide which rules you want to apply, or take turns trying them all out. The activity works best when the drawers and describers switch roles. You can give describers the alternate view of the Toot-A-Loop Radio (Image Thirty-six) when your students switch roles. After ten minutes of describing and drawing, discuss the process with your students. What was the most challenging part of the exercise? Talk to your students about the ways individual perception and language play into this exercise.

- **Next show all your students both images of the Toot-A-Loop Radio (Images Thirty-five and Thirty-six). Have them compare what they see to the drawings they just made. Have your students describe the shape of these objects. What other forms are they reminded of?**

Tell your students that this object is the Toot-A-Loop Radio, designed by Panasonic around 1972. Explain to your students that the Toot-A-Loop Radio was designed to be worn as a bracelet. This particular radio is white, but the Toot-a-Loop was also manufactured in red, orange, and blue to give the user a variety of options. To tune the radio, users twist the loop open to form an S-shape, revealing the tuner inside.

- **Have your students look at both views of this radio and see if they can determine how the object functions (as both radio and bracelet) based on what they see.**

The Toot-A-Loop Radio was cast in acrylonitrile butadiene styrene (ABS) plastic. ABS is an acronym for the three distinct sub-units of the polymer, which, taken together, form a strong material that can be molded into many different forms while maintaining its strength and lightness. This kind of polymer incorporates the attributes of each sub-unit to form a polymer whose properties include the strengths of each individual material. Lego building blocks are made of ABS.

Next show your students the iPod (Image Thirty-seven) by Apple Computer, Inc., Apple Industrial Design Group, and Jonathan Ive. Have each student divide a piece of paper vertically to form two columns. Have them label the left column "Similarities" and the right column "Differences." Have your students list all of the similarities and differences they see between the Toot-A-Loop Radio and the iPod. Debrief by grouping your students' comparisons by category or type. Have your students consider which observations are objective and based on what is visually evident and which observations are subjective and based on what they already know about these objects.

The iPod shell is made out of polycarbonate plastic and stainless steel. Similar to ABS, polycarbonate, a transparent plastic, can be molded into a wide variety of forms. In addition, it can withstand high impact and temperature changes.

- **Ask your students why the designers chose this specific material for the iPod. Why not choose the same material as the designers of the Toot-A-Loop Radio? Ask your students to consider changes in technology between 1972, when the radio was released, and 2001, when the iPod debuted. Ask your students to envision what the iPod might look like in the year 2030. Will it still exist, or will there be a new object in its place?**

ACTIVITIES

Object Timeline

Create an object timeline by organizing the objects discussed in this lesson by the manufacturing date. As a group, discuss the objects based on the information you have generated in the lesson. Ask your students make connections based on materials, process, form, and function. What do the objects have in common aesthetically and functionally? Why did the designers make the choices that they did for each object?

Have your students consider the social, economic, and cultural factors that influenced the design of the objects. Do the objects tell us anything about aspects of society at the time that they were developed? If so, what?

Plastics and the Environment

Have your students work in teams to conduct online research into the environmental impact of plastics. What steps have been taken to mitigate the impact that the use of plastic has on our environment?

FOR FURTHER CONSIDERATION

Bauhaus

Ask your students to research the Bauhaus, a school of art and design founded by Walter Gropius in 1919. What was the focus of the school? What did it aim to do? How did it combine decorative and industrial arts? Who are some artists affiliated with the Bauhaus?

Architecture and Design

Architecture and design are related—many architects also design objects. Ask your students to research designers and architects Ludwig Mies van der Rohe, Alvar Aalto, and Le Corbusier, and report on their work.

Start Your Own Design Collection

Ask your students to each select a type of object to collect. Why will they collect it? What importance does it have to their everyday lives? They can draw or photograph some of the objects, write about them, and present their scholarship to the class.

Recycling

Aluminum and plastic are both recyclable. Have your students each pick one material and research the recycling process. How are the materials transformed? What is the cost of doing so? What impact does recycling have on landfills?

The Films of Charles and Ray Eames

Charles and Ray Eames made over one hundred short films reflecting their interest in design, art, science, and culture. Drawing from their collection of design objects and crafts from around the world, they created films that explore the design process, invention, and innovation while highlighting the beauty of everyday objects. Consult the Resources section of this guide for a Web address for the entire Eames filmography.

Design and Time

Good design objects express something about the time and culture of their origin. Ask your students to select one object addressed in this lesson and research the era in which it was created. What was going on in its country of origin? Ask them to record social and political factors.

GLOSSARY

Arts and Crafts: Informal movement in architecture and the decorative arts in Britain and America around the turn of the twentieth century that championed the unity of the arts, the experience of the individual craftsperson, and the qualities of materials and construction in the work itself.

Constraint: Something that restricts, limits, or regulates.

Consumer: A person who acquires goods or services for direct use or ownership.

Geometric: Resembling or employing the simple rectilinear or curvilinear lines or figures used in geometry.

Inclined plane: A slanting surface, connecting a lower level to a higher level, that objects can be moved up and down. Examples are a slide, stairway, ramp, escalator, and slope.

Industrial design: Art that deals with the design problems of manufactured objects.

Lever: A stiff bar resting on a support, called a fulcrum, that lifts or moves loads. Examples are a shovel, nutcracker, seesaw, and elbow.

Organic: Having characteristics of a living organism or developing in the manner of a living plant or animal.

Plasticizer: Any of a group of substances that are used in plastics or other materials to impart viscosity, flexibility, softness, or other properties to the finished product.

Pliable: Capable of being shaped or bent or drawn out.

Pulley: A simple machine that uses grooved wheels and a rope to raise, lower, or move a load. Examples may be found on a flagpole or crane.

Scale: A proportion used to determine the size relationship between an object and its representation.

Screw: An inclined plane wrapped around a pole that holds things together or lifts materials. Examples are a corkscrew, drill, and jar lid.

Simple machines: Tools designed to make work easier. The six simple machines are a lever, inclined plane, wheel and axle, screw, wedge, and pulley.

Spring: A flexible object that stores mechanical energy when it is twisted.

Wedge: An object with at least one slanting side ending in a sharp edge, which cuts material apart. Examples are a knife, pin, nail, ax, and prow of a boat.

Wheel and axle: A wheel with a rod, called an axle, through its center that lifts or moves loads. Examples may be found on a bicycle, car, and wagon.

Wiener Werkstätte: German for "Vienna workshop." A firm established in 1903 as an association of artists and craftspeople working together to design and manufacture fashionable household goods.

Work: Exertion or effort directed to produce or accomplish something.

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ONLINE RESOURCES

Children as Design Partners: An Introduction (Human Computer Interaction Lab, University of Maryland)
www.cs.umd.edu/hcil/kiddesign

Chronic Homelessness (National Alliance to End Homelessness)
www.endhomelessness.org/section/policy/focusareas/chronic

Cooper-Hewitt, National Design Museum
www.ndm.si.edu

Eames Filmography (Eames Foundation)
http://eamesoffice.com/index2.php?mod=film

History and Design of Propellers (The Boatbuilding.Community)
www.boatbuilding.com/article.php/designofpropellers1

Maslow's Hierarchy of Needs (Educational Psychology Interactive)
http://chiron.valdosta.edu/whuitt/col/regsys/maslow.html

Modern Teachers
www.moma.org/modernteachers

The Museum of Modern Art, New York
www.moma.org

The paraSITE: An inflatable shelter for the homeless that runs off expelled HVAC air (Gizmag)
www.gizmag.com/go/4455/

Post-it: The Whole Story. A NOTE-able Achievement (3M)
www.3m.com/us/office/postit/pastpresent/history_ws.html

Red Studio, A MoMA Site for Teens
www.redstudio.moma.org

Safe: Design Takes on Risk
http://www.moma.org/exhibitions/2005/safe/

Simple and Complex Machines Used in Agriculture (California Foundation for Agriculture in the Classroom)
http://cfaitc.org/LessonPlans/pdf/109.pdf

Simple Machines (Edheads)
www.edheads.org/activities/simple-machines

Simple Machines Learning Site (College of Education, University of Houston)
www.coe.uh.edu/archive/science/science_lessons/scienceles1/finalhome.htm

Social responsibility: The challenge of making your employees comply, with Grundfos chairman Niels Due Jensen (WELL)
www.wellweb.org/Default.asp?Id=108&AjrNws=102&AjrNwsPg=1

SQFlex Combo Drinking Water Pump (Grundfos)
http://net.grundfos.com/doc/webnet/sqflex/frames_flash_mx.htm

The Work of Charles and Ray Eames: A Legacy of Invention (Library of Congress/ Vitra Design Museum)
www.loc.gov/exhibits/eames/furniture.html

TEACHER RESOURCES

Educator Guides with CD-ROMs are available online and in print throughout the year. All schools have unlimited free access to these resources.

Visit Modern Teachers online, at www.moma.org/modernteachers, to connect with MoMA's educator guides, resources, and collection.

For more information, please call (212) 708-9882 or e-mail teacherprograms@moma.org.

PLANNING A MUSEUM VISIT

For more information about school programs, please call (212) 333-1112 or e-mail schoolprograms@moma.org. To schedule a guided discussion with a Museum Educator at MoMA or in your classroom, please contact Group Services at (212) 708-9685 or online at www.moma.org/visit_moma/groups.html#school_etc.

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