WORKS FROM THE PERMANENT COLLECTION

WYSS INSTITUTE SELECTS

JULY 12, 2019–MARCH 8, 2020

COOPER HEWITT

WYSS INSTITUTE SELECTS

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Wyss Institute Selects: Works from the Permanent Collection is curated by members of the Wyss Institute for Biologically Inspired Engineering at Harvard University, led by its founding director, Don Ingber, working in collaboration with his co-faculty, Joanna Aizenberg, Jennifer Lewis, Radhika Nagpal, and Pam Silver. Founded in 2009, the Wyss Institute has become a world leader in biodesign engineering. The Institute has eighteen core faculty members and more than 375 full-time scientific and engineering staff from a broad range of disciplines. The collaborators leverage nature's design principles to develop disruptive technology solutions for healthcare, energy, architecture, robotics, and manufacturing. For the exhibition, the Wyss Institute conceived of the theme of Biofuturism, and selected works from the museum's collection to describe the progression of ideas, objects, visions, and collaborations throughout history that culminated in this new approach to Design Science.

COVER: Hydrodynamics, L'Atome au Service de la Paix (Atoms for Peace), 1955, by Erik Nitsche. Nitsche used natural forms and scientific imagery to suggest an exciting future afforded by new technology.

FACING PAGE: Time Capsule, designed 1954, printed 1988, by Ben Rose. This mid-century textile reflected an interest in scientific and mathematical forms and is reminiscent of Buckminster Fuller's geodesic domes (see page 9).

The Biofuturism vision is a new formulation of the Futurism art and design movement that spread across Europe and the world in the early twentieth century, celebrating the energy and form-shaping dynamism of modern technology. The pioneering Futurist visionaries believed that their art would hurtle the world into the future, and they practiced in virtually every medium, ranging from painting, sculpture, theater, film, and architecture to graphic, industrial, interior, urban, and textile design. One century later, the Wyss Institute is helping to birth a Biofuturism movement that looks to nature for inspiration, and that uses biological design principles to create technologies for a broad range of medical, industrial, and environmental applications. It too is led by visionaries who work in virtually every medium and collaborate across various disciplines. A similar movement is emerging in the art and design communities, as is evidenced by contributions to *Nature—Cooper Hewitt Design Triennial*, currently on view at the museum (through January 20, 2020). In this Selects exhibition, the Wyss Institute team uses objects in Cooper Hewitt's permanent collection and borrows from Smithsonian's Hirshhorn Museum and Wyss Institute to explore how Biofuturism can go beyond art anticipating the future and, instead, use design to engineer a better world.

Wyss Institute Selects is the eighteenth installment in the Selects series and the first time a scientific institution has curated an exhibition in the series. *Wyss Institute Selects* is installed in the Nancy and Edwin Marks Gallery, devoted to featuring objects in Cooper Hewitt's permanent collection.

***Wyss Institute Selects* is made possible by the Marks Family Foundation Endowment Fund.**

BIOFUTURISM

by Don Ingber, Founding Director, Wyss Institute

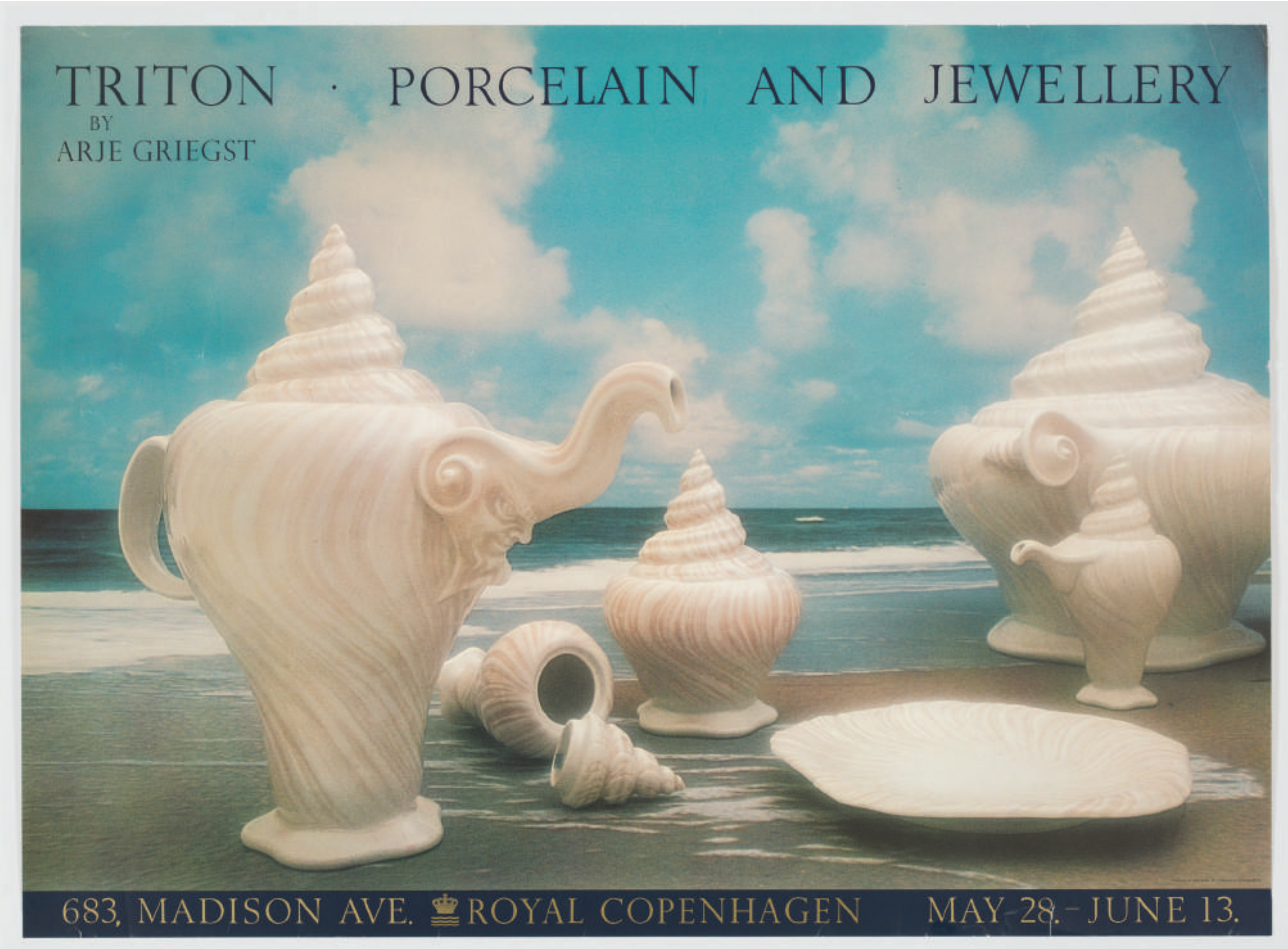
As active scientists and engineers at the Wyss Institute, we were surprised and honored to be invited by Cooper Hewitt to curate a Selects collection in parallel with their *Nature* exhibition. As we all have had long-held interests in art, architecture, and design, and have been meaningfully inspired in our own scientific research by these fields, being provided access to the huge and wondrous collection of artifacts available through the museum and its partner institutions was like being the proverbial "kids in a candy store."

This exhibition was inspired by the Futurism design and art movement that garnered great attention at the beginning of the twentieth century. The movement attempted to visualize how the world was dynamically transforming as a result of accelerating advances in industrialization and technological development. Proponents of Futurism, such as poet Filippo Tommaso Marinetti, whose "Futurist Manifesto" was published in 1909, turned away from the past and embraced the incredible power of technology and automation that they could see would define their future. Regardless of whether they were writers, painters, sculptors, architects, or designers, they strived to convey the plastic and dynamic nature of their changing world and the underlying forces that drive these metamorphic transformations. This is an apt starting point for our curated selections because the Wyss Institute is helping to drive a new technology wave with world-transforming potential. We combine design with new advances in science, engineering, medicine, and industry at the beginning of the twenty-first century, while looking to nature for inspiration. But research at the Wyss Institute goes beyond mimicry of macro- and microscale patterns and forms found in nature. The work seeks to understand nature's design principles and leverage them to develop new technological innovations in potential applications across all scales. In essence, we are helping to advance a Biofuturism movement, and we too design in a broad range of fields from bioinspired robotics, architectural materials, and biomanufacturing to 3D-printed medical devices and nanotherapeutics.

> *"When I pondered the challenge before us, a memory from when I was an undergraduate student popped into my head. I remembered first seeing the works of a group of designers and artists who called themselves 'Futurists.' Their goal was to anticipate a future that would be improved through technology innovation, and to influence others through their work. Their vision resonates deeply with our own; however, we at the Wyss Institute go beyond depiction and actually use design to guide development and commercialization of new bioinspired technologies, which we hope will redefine our future and make the world better for all."*
>
> **DON INGBER**

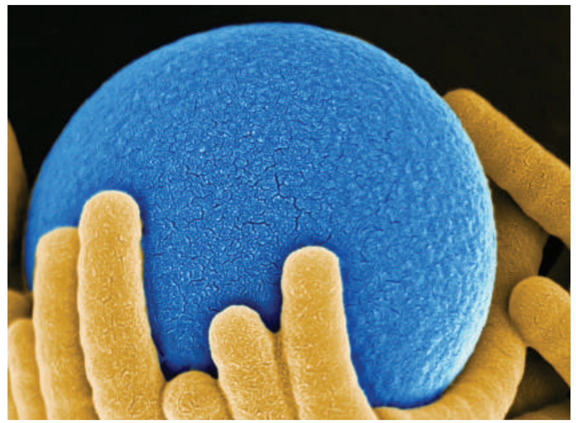
Robobee, 2012, by Kevin Y. Ma and Robert J. Wood. This flying robot was inspired by the honeybee and has potential applications for search and rescue missions and environmental monitoring.

FACING PAGE: *Le Soir, Couchée dans son lit, elle relisait la lettre de son artilleur au front (In the Evening, Lying on Her Bed, She Reread the Letter from Her Artilleryman at the Front)*, created 1917 by Filippo Tommaso Marinetti, published 1919, in *Les mots en liberté futuristes (Futurist Words in Freedom)*. Marinetti's poetry and illustrations captured the ethos of Futurist thinking.



Top: Poster, ca. 1977 and **Bottom:** Tea Service, Triton, 1973–76, by Arje Griegst. Taking inspiration from spiral-shaped seashells, Griegst's porcelain also references Triton, son of Poseidon, who is depicted as a merman.

Spiral Staircase Model, 19th century.



Save Our Earth, 2009, by Joanna Aizenberg (Russian, b. 1960) and Wim Noorduin (Dutch, b. 1980). Synthetic cillia are shown demonstrating the the principle of self-assembly.

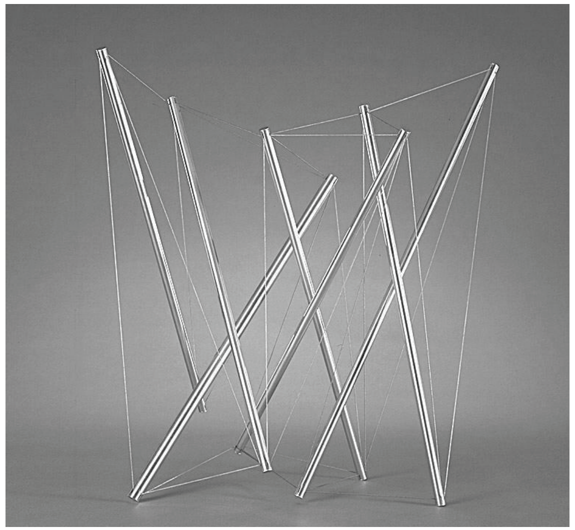
BIOINSPIRATION

Artists and designers have been influenced by nature from the first time a prehistoric man or woman picked up a stone and chiseled a carving tool in the form of an animal tooth or fingered a charcoal and sketched an image of a bison on a cave wall. Humans have always learned from the world around them and they included what they saw in their own designs. To visualize this form of bioinspiration, we chose to explore how the natural beauty and harmony of a single natural form—the "spiral" seen in shells or fossils—has sparked the imagination of artists and designers working in virtually every medium throughout time. The organic form of the spiral has been used again and again, whether in a beautiful staircase model (left), piece of jewelry, candlestick, tea set (facing page), or monumental land sculpture. The same eternal spiral has been used to garner attention, advertise, and even sell the positive value of atomic energy (see cover image).

> *Bioinspiration to me is looking into intricate forms and structures that nature builds, uncovering remarkable properties of naturally occurring materials that evolved over millions of years, reducing their very complex structures to a manageable number of parameters, and applying these mechanisms and approaches to designing materials of the future. It is extremely exciting and enormously rewarding, especially when we can combine several totally unrelated features we found in different organisms to create futuristic hybrid systems that allow us to reach materials properties that were unimaginable even a decade ago . . .*
>
> **JOANNA AIZENBERG**

THE ARCHITECTURE OF LIFE

As in the case of the spiral, most artists and designers have been impacted by natural forms at a scale that they can see with their own eyes. However, some have delved further to understand the rules that govern how natural forms take their shapes. Plato and his school of Greek philosophers were inspired by the triangulated facets of worn stones in riverbeds and natural crystals, and they first proposed that geometry in the form of triangulated shapes, such as tetrahedra, serves as the basic building block of life. Indeed, 3D polyhedral forms have intrigued artists and designers (see p. 2), as well as mathematicians and architects, throughout the ages, culminating in the invention of the triangulated geodesic dome of R. Buckminster Fuller (opposite, right) that closely resembles the icosahedral shape of viruses at the microscale. Fuller helped to birth a new field of Design Science in which the power of design is harnessed to make the world a better place for all. The Wyss Institute is dedicated to advancing this vision through biodesign engineering.



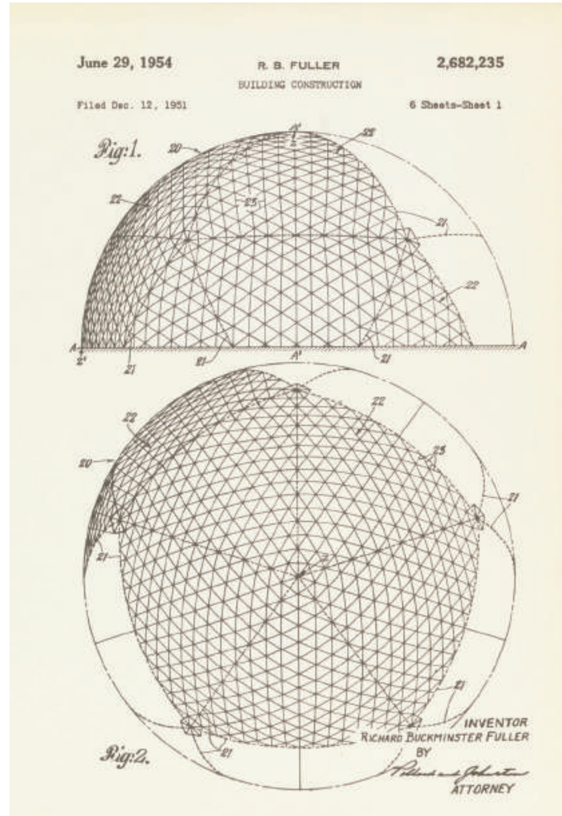
Model for "Greene Guide," 1975, by Kenneth Snelson. Snelson's tensegrity structures are composed of both rigid and flexible components.

86T Rocking Stool, 1954, by Isamu Noguchi. The stool's design recalls the form of an atomic structure, a scientific motif popular with mid-century designers.

But to understand how nature builds, one must go beyond form. As the scientist D'Arcy Thompson wrote in his classic tome *On Growth and Form* (also written almost exactly one century ago), natural patterns provide us with a clue because they are "diagrams of underlying forces." Fuller understood this and strived to explain why the geodesic dome is so strong and efficient in terms of its load-bearing properties. He came to realize that as opposed to most man-made structures that depend on continuous transmission of compressive forces due to gravity (think of

Hanging, 1973, by Peter Collingwood. Textile designer Collingwood—consumed by his interest in structure—combined rigid wefts (the horizontal element) with flexible warps (the vertical element) to create a textile that echoes tensegrity structures.

Stonehenge or a brick building), tensional forces are often used to stabilize natural structures (imagine a spider web or an inchworm). It was not until he inspired his student—the young sculptor Kenneth Snelson—to build a structure composed of multiple stiff struts that did not physically touch, but were pulled up and open through interconnection with a series of tensile cables, that his concept of tensegrity (tensional integrity) became clear to others. Tensegrity also explains how we stabilize our bodies, which are composed of multiple stiff, compression-bearing bones interconnected by tensed muscles, tendons, and ligaments. It also has inspired scientific work by Don Ingber, which has resulted in the discovery that this fundamental design principle governs how molecules, cells, tissues, and organs self-assemble, stabilize their shape, and control their function. Radhika Nagpal has leveraged the same principles to create tensegrity-based robots that crawl and build (see p. 13).



U.S. patent for Geodesic Dome construction (facsimile), 1958, by R. Buckminster Fuller. Fuller was Kenneth Snelson's teacher and introduced him to the idea of tensegrity, which Fuller also incorporated in his geodesic dome construction.

SYNTHETIC WORLDS

Throughout history, designers have leveraged their appreciation of natural forms to create synthetic worlds inhabited by artificial flora and fauna that are limited only by the imagination. Inspired by the beauty of natural objects, artists have explored whether they can do better by creating fantastical creatures (below), textiles populated with a sea filled with primitive organisms (facing page), and light fixtures encrusted with blown glass forms that are reminiscent of barnacles (right). Scientists who work in the emerging field of synthetic biology take another approach to create artificial life. Pam Silver is creating a bionic leaf that uses power generated by a man-made solar energy cell to split water into hydrogen and oxygen. The hydrogen is consumed along with carbon dioxide by genetically engineered bacteria captured within the engineered leaf that produce liquid fuel while the oxygen is released, much like a living plant. Still other designers also have questioned what future worlds may look like and whether the things we design will end up designing us, which is truly a new type of artistic Futurism.

> *We design at the interface between the natural and the physical world to capture and use sunlight—our greatest natural resource. In doing so, we invented a programmable bionic leaf to provide food, fuel, and materials. This is a hybrid physical/biological system inspired by photosynthesis itself, but it is more efficient, can operate in harsh environments, and closely follows its biological inspiration.*
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> **PAM SILVER**

FACING PAGE:. Tharrakarre, 1989, Judith Kngwarreye. Native and unusual plants, reptiles, and insects from Australia compose this dynamic batik textile pattern.

Wall Sconce, 1996, by Dale Chihuly.

> *By integrating advances in materials science, developmental biology and tissue engineering with new 3D bioprinting tools, we are creating vascularized human tissues that will one day repair, regenerate, and, ultimately, replace vital organs in the human body.*
>
> **JENNIFER LEWIS**

Parade Float with The Virgin and Child riding a Dragon, plate 8 from Alfonso Isacchi, *Relatione intorno l'origine, solennità, traslatione, et miracoli della Madonna di Reggio* (Account of the Origin, Festivals, Procession, and Miracles of the Virgin of Reggio), 1619, by Giovanni Luigi Valesio. The print documents a fantastical fire-breathing dragon that is a float for an important occasion in the seventeenth century.

BIOLOGICALLY INSPIRED ENGINEERING

The vision of the Wyss Institute is to innovate by emulating the way nature builds, but this form of biologically inspired engineering goes beyond mimicry of macroscale patterns, forms, and structures. Advances in our understanding of how nature builds at invisibly small size scales have been made possible through microscopic imaging. As a result, designers and scientists can create structures that leverage the underlying principles that provide living organisms with their incredible strength, resilience, and efficiency. Designers, material scientists, engineers, and physicians have collaborated to design and fabricate clothing, devices (right), and prosthetics (below) that seamlessly integrate with our bodies, restore lost functions, and even provide superhuman capabilities. At the Wyss Institute, Don Ingber has created human organ-on-a-chip microdevices with tiny hollow channels lined with living human cells and tissues that experience fluid flow and physical motions. The devices recapitulate human organ functions as a way to replace animal testing to advance personalized medicine. Jennifer Lewis also has 3D-printed vascularized human tissues that recreate the structure and function of living organs—such as the kidney—someday may be used to print replacements for lost body parts on demand. Some of these bioinspired technologies have been commercialized as well. Through these efforts, the boundaries between living and nonliving systems are beginning to literally break down. As the methods used by artists, designers, engineers, and scientists converge, the Biofuturist palette that we have to paint the future becomes broader and deeper than ever before; it is up to us to decide what we make with it.

Bioimplantable Device for Reconstructive Shoulder Surgery, 2004, by Ellis Developments Ltd. Embroidery mimics the natural fibrous arrays of ligaments, and this implant acts as a scaffold for new tissue growth.

Flex-Foot Cheetah® Xtend Running Blade, designed before 2000, manufactured 2013, by Van Phillips. This prosthetic sprinting foot, which acts like a springboard, is based on the shape of the rear leg of a cheetah.

> *When I look at the intricate patterns of cells in a fruit fly wing, or the intricate patterns of army ants self-assembled into a nomadic nest, or the intricate patterns of fish schools that move as one through a coral reef, I am always struck by the feeling of unity—a single entity composed of many pieces. Self-assembly occurs across natural scales, in a way that is in synergy with the materials and organisms, and in a way that is self-stabilizing and self-repairing. Living architecture. That idea has profound meaning for engineers, like me, both in computation and physical design of robots.*
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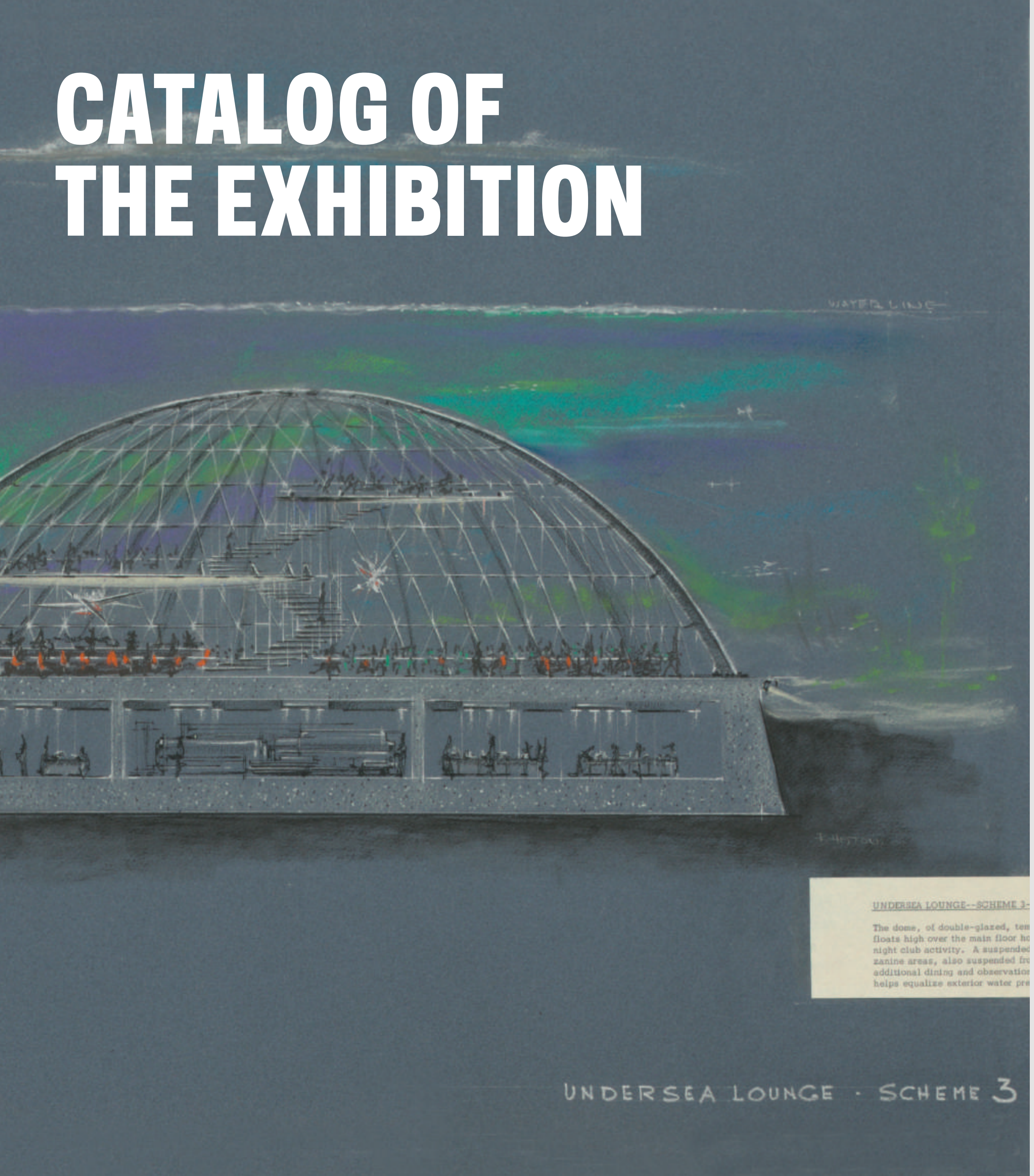
> **RADHIKA NAGPAL**

Kilobots, 2012, by Radhika Nagppa (American, b. 1971), Mike Rubenstein (American, b. 1980), and the Self-Organizing Systems Research Group. These Kilobots demonstrate how thousands of simple robots, with no leader, can self-organize complex shape and behavior.

CATALOG OF THE EXHIBITION



Print, *Fuochi D'Artificio (particolare)* (Fireworks, Detail), *Progetti scenici per "sintesi futuriste" 1915/1925* (Set Designs for Futurist Syntheses 1915/1925), ca. 1980; Designed by Giacomo Balla (Italian, 1871–1958); Published by Edizioni Franca Mancini (Pesaro, Italy); Lithograph on heavy white wove paper; Platemark: 49.7 × 35.2 cm (19 9⁄16 × 13 7⁄8 in.), Sheet: 68.6 × 49.2 cm (27 × 19 3⁄8 in.); Gift of Tamar Cohen, 1999-6-5-8

Book Foldout, *Le Soir, Couchée dans son lit, elle relisait la lettre de son artilleur au front (In the Evening, Lying on Her Bed, She Reread the Letter from Her Artilleryman at the Front)*, created 1917 by Filippo Tommaso Marinetti, published 1919, in *Les mots en liberté futuristes (Futurist Words in Freedom)*; Written and designed by Filippo Tommaso Marinetti (Italian, 1876–1944); Published by Edizioni futuriste di "Poesia" (Milan, Italy); Letterpress on paper; 34.5 × 23.5 cm (13 1⁄2 × 9 1⁄4 in.); Smithsonian Libraries, PQ4829 .A76M6X; Gift of Kahn Brothers in Honor of Michele Davidow Kahn, SIL39088015314685

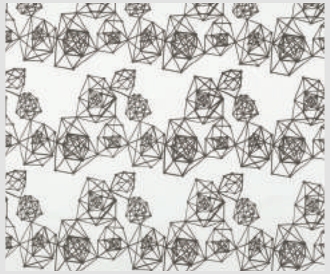
Print, Design for the Ten-Deck House, June 16, 1928; Designed by R. Buckminster Fuller (American, 1895–1983); Mimeograph print, brush and blue watercolor on white paper; 27.9 × 21.6 cm (11 × 8 1⁄2 in.); Museum purchase from Smithsonian Institution Collections Acquisition Program Fund, 1991-53-1

Drawing, Design for the Ten-Deck House, 1928; Designed by R. Buckminster Fuller (American, 1895–1983); Graphite on white wove paper; 27.9 × 21.6 cm (11 × 8 1⁄2 in.); Museum purchase from Smithsonian Institution Collections Acquisition Program Fund, 1991-53-2

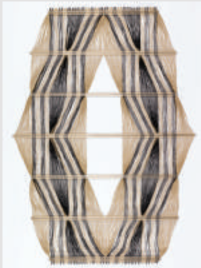
Drawing, Design for Undersea Lounge: Scheme 3, Main Level, Interior Perspective, ca. 1965; Designed by Donald Deskey (American, 1894–1989) and Russell Heston (American, b. 1929); Drafted by Russell Heston; Pastel crayon on blue wove paper mounted on presentation board; 49.8 × 65 cm (19 5⁄8 × 25 9⁄16 in.); Gift of Donald Deskey, 1988-101-1507

Drawing, Design for Undersea Lounge: Scheme 3, Main Level, ca. 1965; Designed by Donald Deskey (American, 1894–1989) and Russell Heston (American, b. 1929); Drafted by Russell Heston; Pastel crayon on blue wove paper mounted on presentation board; 50.3 × 65.1 cm (19 13⁄16 × 25 5⁄8 in.); Gift of Donald Deskey, 1988-101-1502

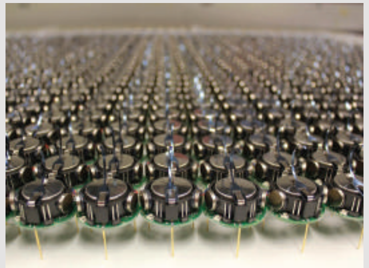
ARCHITECTURE OF LIFE



Textile: Time Capsule, designed 1954, printed 1988; Designed by Ben Rose (American, 1916–2004); Manufactured by Ben Rose Inc. (Chicago, Illinois, USA); Hand screen-printed cotton plain weave; 301 × 131.8 cm (9 ft. 10 ½ in. × 51 ⅞ in.); Gift of Mr. and Mrs. Ben Rose through The Art Institute of Chicago, 1989-62-10; Photo © Smithsonian Institution

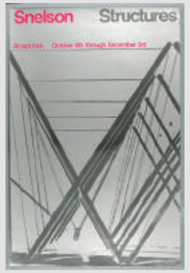


Hanging, 1973; Designed and made by Peter Collingwood (British, 1922–2008); Linen macro gauze with metal rod wefts; 148 × 104 cm (58 ¼ × 40 15/16 in.); Museum purchase from Friends of Textiles Fund, 1976-37-1

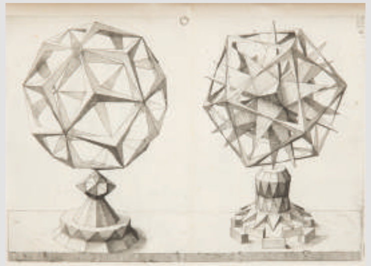


Kilobots, 2012; Designed by Radhika Nagpal (American, b. 1971), Mike Rubenstein (American, b. 1980), and the Self-Organizing Systems Research Group; Robotics; Diameter: 3 × 3 cm (1 ⅛ × 1 ⅛ in.); Courtesy of Wyss Institute for Biologically Inspired Engineering at Harvard University

Basket, 1982; Designed and made by John McQueen (American, b. 1943); Basswood woven in bobbin lace technique; 26.7 × 19.1 cm (10 ½ × 7 ½ in.); Museum purchase through Exhibition Funds, 1982-24-1



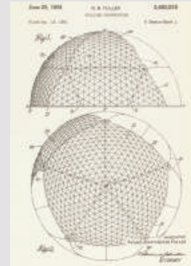
Poster, Snelson Structures, 1968; Designed by Peter Gee (British, active USA, 1932–2005); Silkscreen on aluminized paper; 114 × 75.5 cm (44 ⅞ × 29 ¾ in.); Museum purchase from Friends of Drawings and Prints Fund, 1976-25-1



Bound Print, *Polyhedral Variants, plate O (F.IIII) in Wenzel Jamnitzer, Perspectiva Corporum Regularium* (Perspective of the Regular Bodies), 1568; Designed by Wenzel Jamnitzer (German, 1508–1584); Etched by Jost Amman (Swiss, 1539–1591); Published by Christoph Heussler (Nurember, Germany); Etching on laid paper; 23.3 × 35.5 cm (9 5/16 × 14 in.); Museum purchase through gift of the Estate of David Wolfe Bishop, 1957-192-3-37

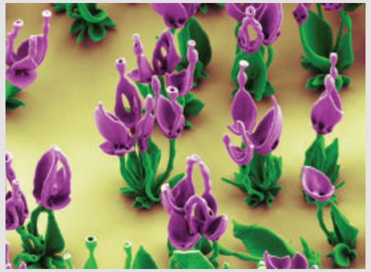
Sculpture, Model for "Greene Guide," 1975; Designed by Kenneth Snelson (American, 1927–2016); Aluminum and stainless-steel wire; 44.1 × 40.6 × 21.1 cm (17 ⅜ × 16 × 8 ⅜ in.); Courtesy of Hirshhorn Museum and Sculpture Garden, Smithsonian Institution; Photo by Lee Stalsworth

Book Cover, R. Buckminster Fuller, Makers of Contemporary Architecture Series, 1963; Designed by Elaine Lustig Cohen (American, 1927–2016); Published by George Braziller (New York, New York, USA); Written by John McHale (British, 1922–1978); Offset lithograph on glossy white paper; 26.7 × 48 cm (10 ½ × 18 ⅞ in.); Gift of Tamar Cohen and Dave Slatoff, 1993-31-51

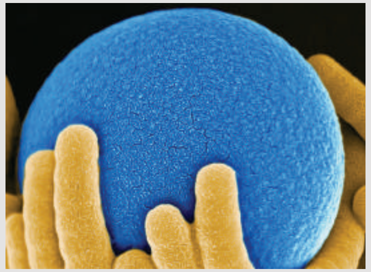


Book Plate, U.S. patent for Geodesic Dome construction, facsimile; Filed 1951, patent issued 1954, book published 1958; Published in *Buckminster Fuller (The Quadrat-Prints series)*; Designed by by R. Buckminster Fuller (American, 1895–1983); Published by Steendrukkerij De Jong & Co. (Hilversum, Netherlands); Edited by Pieter Brattinga (Dutch, 1931–2004); Lithograph on paper; 25 × 25 cm (9 ¾ × 9 ¾ in.); Smithsonian Libraries, NA737.F96 A4, SIL39088013299979

86T Rocking Stool, 1954; Designed by Isamu Noguchi (American, 1904–1988); Manufactured by Knoll Inc. (New York, New York, USA); Birch, chrome-plated steel rods; 41.9 × 35.6 cm (16 ½ × 14 in.) Gift of George R. Kravis II, 2016-5-13

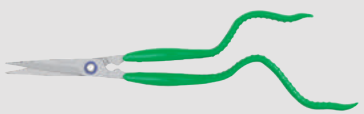


Digital Print, Synthetic Crystal Nanoflowers, 2013; Designed by Joanna Aizenberg (Russian, b. 1960) and Wim Noorduin (Dutch, b. 1980); Micrograph by Wim Noorduin; Synthetic crystal flowers sculpted at the nanoscale using timed interventions in molecular self-assembly and shown in a scanning electron micrograph image with false color; Each flower is approximately 10 micrometers, one tenth the size of a human hair; Courtesy of Aizenberg Lab and Wyss Institute for Biologically Inspired Engineering at Harvard University



Digital Print, Save Our Earth, 2009; Designed by Joanna Aizenberg (Russian, b. 1960) and Wim Noorduin (Dutch, b. 1980); Synthetic cilia demonstrating the principle of self-assembly around a nanosphere and shown in a scanning electron micrograph with false color; Each synthetic cilia is approximately the size of a naturally occurring cilia (200 nanometers in diameter); Courtesy of Aizenberg Lab and Wyss Institute for Biologically Inspired Engineering at Harvard University

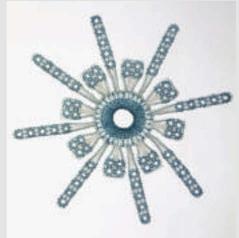
Poster, Artificial Nature, 1990; Designed by Dan Friedman (American, 1945–1995) for Deste Foundation for Contemporary Art (Athens, Greece); Offset lithograph on paper; 61.7 × 81 cm (24 5⁄16 × 31 7⁄8 in.); Gift of Ken Friedman, 1997-19-432



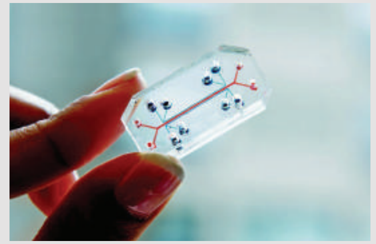
Shape Memory Scissors, 1997; Designed by Naoyoshi Machida (Japanese, date unknown); Manufactured by Ukai-Riki/Gifu Seki Cutlery Industry Association (Seki, Japan); Steel, polyurethane resin; 27.3 × 6.4 × 1 cm (10 3⁄4 × 2 1⁄2 × 3⁄8 in.); Gift of Gallery 91, 2014-47-10

Brooch, 2015; Designed and made by Kazumi Nagano (Japanese, b. 1946); Folded linen paper, nylon thread, gold wire, silver; 11.3 × 8 × 4.1 cm (4 7⁄16 × 3 1⁄8 × 1 5⁄8 in.); The Susan Grant Lewin Collection, Cooper Hewitt, Smithsonian Design Museum, 2016-34-74

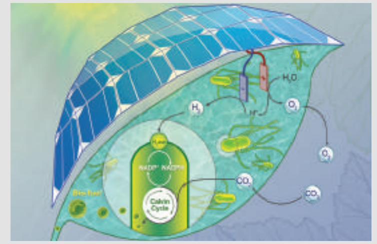
Robobee, 2012; Designed by Kevin Y. Ma (American, b. 1988) and Robert J. Wood (American, b. 1977) with Pakpong Chirarattananon, Sawyer B. Fuller, Harvard School of Engineering and Applied Sciences (Cambridge, MA, USA) and Wyss Institute for Biologically Inspired Engineering at Harvard University; Piezoelectric ceramic, carbon fiber, alumina ceramic; polyester film, carbon-fiber composite frame; polyimide-film, carbon-fiber, Garolite glass-fiber composites; Manufacturing processes: laser micromachining; high-temperature, high-pressure lamination; manual assembly with tweezers; 2 × 3 cm (3⁄16 × 1 3⁄16 in.); Gift of Harvard John A. Paulson School of Engineering and Applied Sciences, 2015-23-1



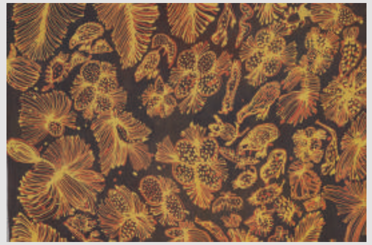
Bioimplantable Device for Reconstructive Shoulder Surgery, 2004; Designed by Prof. Simon Frostick (British, b. 1956) and Dr. Alan McLeod (British, b. 1964); Textile designed by Peter Butcher (British, b. 1947); Developed by Ellis Developments Ltd. (Nottinghamshire, England, United Kingdom); Manufactured by Pearsalls Ltd. (Taunton, Sommerset, England, United Kingdom); Machine-embroidered polyester (base cloth dissolved); Diameter: 14.3 cm (5 5⁄8 in.); Gift of Ellis Developments Ltd., 2004-15-1



Organ-on-a-Chip, 2009; Designed by Donald Ingber (American, b. 1956) and Dongeun Huh (Korean, b. 1975); Microfabricated device composed of silicone rubber; 3.5 × 0.5 × 2 cm (1 3⁄8 x 13⁄16 x 13⁄16 in.); Courtesy of Wyss Institute for Biologically Inspired Engineering at Harvard University



Digital Print, The Bionic Leaf, 2019; Designed by Pamela Silver (American, b. 1952) and Dan Nocera (American, b. 1957); Schematic designed in collaboration with Donald Ingber (American, b. 1956); Drawing by Lei Jin (American, b. 1976); Courtesy of Wyss Institute for Biologically Inspired Engineering at Harvard University



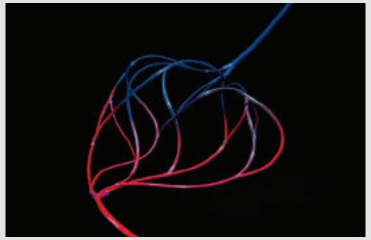
Textile: Tharrakarre, 1989; Designed and printed by Judith Kngwarreye (Australian, dates unknown); Wax resist–dyed silk (batik); 393.7 × 134.6 cm (12 ft. 11 in. × 53 in.); Museum purchase through bequest of Ida McNeil in memory of Lincoln C. McNeil and Catherine McNeil and from Pauline Cooper Noyes Fund, 1992-21-1; Photo © Smithsonian Institution

Drawing, Design for Unidentified Object in Robot Form, ca. 1980; Designed by Dan Friedman (American, 1945–1995); Graphite, red crayon on white paper; 27.9 × 21.7 cm (11 × 8 9⁄16 in.); Gift of Ken Friedman, 1997-19-343

Platter, 19th century; After Bernard Palissy (French, 1510–1590); Lead-glazed earthenware; 7 × 52 cm (2 3⁄4 × 20 1⁄2 × 16 in.); Gift of Francis B. Lothrop, Mrs. George Batchelder, and Jordan Abbott; 1957-29-2; Photo © Smithsonian Institution

SYNTHETIC BIOLOGY CONT'D.

Wall Sconce, 1996; Designed by Dale Chihuly (American, b. 1971); Blown glass, metal; 69.9 × 49.5 × 31.8 cm (27 ½ × 19 ½ × 12 ½ in.); Gift of Barbaralee Diamonstein-Spielvogel, 2007-31-1



Vascular Tree, 2018–ongoing; Designed by Sanlin Robinson (American, b. 1988), Neil Lin (Taiwanese, b. 1985), and Jennifer Lewis (American, b. 1964); Silicone tubing filled with dyed polydimethylsiloxane; 121.92 × 45.72 × 45.72 cm (48 × 18 × 18 in.); Courtesy of Wyss Institute for Biologically Inspired Engineering at Harvard University

Print, Parade Float with The Virgin and Child riding a Dragon, plate 8 from *Alfonso Isacchi, Relatione intorno l'origine, solennità, traslatione, et miracoli della Madonna di Reggio* (Account of the Origin, Festivals, Procession, and Miracles of the Virgin of Reggio), 1619; Designed and engraved by Giovanni Luigi Valesio (Italian, ca. 1583-1633); Published by Flaminio Bartoli (Reggio Emilia, Italy); Engraving on laid paper; 23.2 × 32.5 cm (9 1⁄8 × 12 13⁄16 in.); Museum purchase through gift of various donors and from Eleanor G. Hewitt Fund, 1938-88-8560

BIOFUTURISM

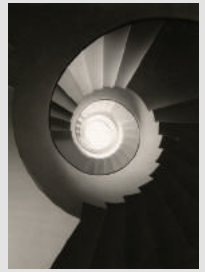
Sport Top, Running Tights, Balaclava, Sports Cuffs, 2016; Designed by Jörg Hartmann (German, b. 1961); Design team: Karen Klabunde (German, b. 1985), Petra Meyer (German, b. 1965), Francesco Collura (Italian, b. 1968); Manufactured by H. Stoll AG & Co. KG (Reutlingen, Germany); Knitted virgin wool, Lycra, polyamide, polyester, polyester reflector yarns, copper; Gift of H. Stoll AG & Co. KG, 2017-49-1/4-a,b; © H. Stoll AG & Co. KG

Flex-Foot Cheetah® Xtend Running Blade, designed before 2000, manufactured 2013; Designed by Van Phillips (American, b. 1954), updated by Christophe Lecomte (French, b. 1979); Engineered by Hilary Pouchak (American, b. 1958); Manufactured by Össur (Aliso Viejo, California, USA), Newport Adhesives & Composites (composite materials), and Mitsubishi Rayon (fiber); Molded plain-woven carbon fiber, unidirectional carbon-fiber epoxy resin; 51 × 7 × 31.7 cm (20 1⁄16 × 2 ¾ × 12 ½ in.) Gift of Össur North America, 2015-49-1

Prosthetic Leg Prototype, 2014; Designed by Scott Summit (American, b. 1967); Printed by 3D Systems (Rockhill, South Carolina, USA); Selective laser-sintered polyamide (nylon); 76.2 × 30.5 × 15.2 cm (30 × 12 × 6 in.); Gift of 3D Systems, 2016-2-2

NATURAL FORMS

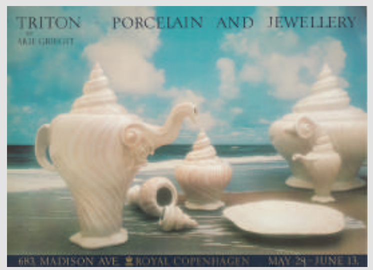
Turret Earrings, 1986; Designed by Ted Muehling (American, b. 1953); Bronze, gold wire; Each earring: 5.7 × 1.8 × 1.6 cm (2 ¼ × 11⁄16 × 5⁄8 in.); Gift of Susan M. Yecies, 2011-19-1-a,b



Photograph, Spiral Staircase in Robert Mallet-Stevens House in Paris, ca. 1927; Photograph by M. Therese Bonney (American, 1894–1978); Architect: Robert Mallet-Stevens (French, 1886–1945); 24.25 × 18 cm (9 ½ × 7 ¼ in.); Smithsonian Libraries, 2000-42-1

Escargot Vase, 1920; Designed by René Lalique (French, 1860–1945); Manufactured by Lalique et Cie (France); Mold-blown and acid-etched glass; 21.2 × 19.5 × 7.2 cm (8 3⁄8 × 7 11⁄16 × 2 13⁄16 in.); Museum purchase through gift of Eleanor Garnier Hewitt, 1969-91-1; 1969-91-1; Photo © Smithsonian Institution

Saucer, Cup, Teapot, Sugar Bowl, Cream Jug, and Sauceboat from the *Konkylie* (Triton) Service, 1973–76; Designed by Arje Griegst (Danish, 1938–2016); Manufactured by Royal Copenhagen; porcelain; Gift of Royal Copenhagen Porcelain Co., 1982-65-1 through 1982-65-6-a,b; Photo © Smithsonian Institution



Poster, Triton by Arje Griegst, ca. 1977; Printed by Permild & Rosengreen, Roskilde, Denmark for Royal Copenhagen Porcelain Manufactory, featuring porcelain by Arje Griegst (Danish, 1938–2016); Offset lithograph on paper; 61.5 × 84.4 cm (24 3⁄16 × 33 3⁄8 in.); Gift of Unknown Donor, 1984-49-1

Poster, Hydrodynamics, *L'Atome au Service de la Paix* (Atoms for Peace), 1955; Designed by Erik Nitsche (Swiss, 1908–1998) for General Dynamics Corporation (Falls Church, Virginia, USA); Offset lithograph on paper mounted on canvas; 126.5 × 89 cm (49 13⁄16 × 35 1⁄16 in.); Gift of Arthur Cohen and Daryl Otte in memory of Bill Moggridge, 2013-42-9

Poster, Movie Treatment for Spiral Jetty, Great Salt Lake, Utah, 1970; Designed by Robert Smithson (American, 1938–1973) for Dwan Gallery; Offset lithograph on paper; 96.5 × 55.5 cm (38 × 21 7⁄8 in.); Museum purchase from General Acquisitions Endowment and Smithsonian Institution Collections Acquisition Program Funds, 1999-45-25

Armchair, ca. 1860; Manufactured by Gebrüder Thonet (Austria); Beechwood, rattan; 98.5 × 62.5 × 68.5 cm (38 ¾ × 24 ⅝ × 26 15/16 in.); Bent beechwood, caning; H × W × D: 98.5 × 62.5 × 68.5 cm (38 ¾ × 24 ⅝ × 26 15/16 in.); Gift of Thonet Industries, Inc., 1971-19-1; Photo © Smithsonian Institution

NATURAL FORMS CONT'D.

Candleholder (possibly French), 18th century; Iron, wood; 20 × 7.8 × 7.5 cm (7 ⅞ × 3 1/16 × 2 15/16 in.); Anonymous Gift, 1952-166-35

Spiral Staircase Model (French), 19th century; Pearwood; 44 × 16.5 × 16.2 cm (17 5/16 × 6 ½ × 6 ⅜ in.); Gift of Eugene V. and Clare E. Thaw, 2007-45-4; Photo by James Hart © Smithsonian Institution

Vegetal Chair, 2009; Designed by Erwan Bouroullec (French, b. 1976) and Ronan Bouroullec (French, b. 1971); Manufactured by Vitra AG (Birsfelden, Switzerland); Injection-molded polyamide; 81.3 × 60.3 × 57.8 cm (32 × 23 ¾ × 22 ¾ in.); Gift of Vitra, 2010-41-2; Photo © Smithsonian Institution

BACK COVER: Save Our Earth, 2009; Designed by Joanna Aizenberg (Russian, b. 1960) and Wim Noorduin (Dutch, b. 1980); Synthetic cilia demonstrating the principle of self-assembly around a spherical nanosphere and illustrated through scanning electron micrograph with false color; Each synthetic cilium is approximately the size of a naturally occurring cilium (200 nanometers in diameter); Courtesy of Aizenberg Lab and Wyss Institute for Biologically Inspired Engineering at Harvard University.

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Photography by Matt Flynn © Smithsonian Institution, unless otherwise stated.
Design: Christa May

Printed on FSC-certified recycled paper in the United States of America.


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NEW YORK NY 10128
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