

AN EDUCATOR'S RESOURCE GUIDE



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CHIHULY IN THE GARDEN 2023

Chihuly in the Garden 2023 presents the work of world-renowned artist Dale Chihuly in a stunning exhibition uniting art and nature. Thousands of pieces of blown glass forms in 18 dramatic installations throughout the Garden's grounds present these artworks on a grand scale. Chihuly brings art lovers outside and draws inspiration from the Garden's landscape and uses form and color to ignite joy. *Chihuly in the Garden 2023* has been curated for the Missouri Botanical Garden, taking advantage of our stunning vistas and unique vegetation. The Garden hosts this stunning exhibition uniting art and nature May 2 through October 15, 2023.

Admission to *Chihuly in the Garden 2023* is free with your self-guided visit for all ZMD students (St. Louis City and St. Louis County), and non-ZMD students in grades PreK-8th. Non-ZMD students in grades 9 and above are admitted at \$8 per student. For every 5 students attending a self-guided visit, 1 adult is admitted at no cost. Additional chaperone's are admitted at standard admission rates.

Tips for the Best Experience

- Pre-register your self guided visit online at www.mobot.org.
- Review with your bus driver the drop off and pick up location of students in addition to the overflow bus parking spots.
- Locate the online map of the Missouri Botanical Garden with locations of exhibit pieces.
- Download and print the cross curricular learner guide associated with your students grade level.
- Schools are encouraged to pay all admission fees prior to arriving at the Missouri Botanical Garden.

Note: no tripods or monopods will be allowed during the Chihuly exhibit.



Lead Sponsors:



©2023 Missouri Botanical Garden | Art credits, cover: Dale Chihuly, *Float Boat*, 2014, and *Niijima Floats*, 2023. Missouri Botanical Garden, St. Louis, installed 2023. Back cover: Dale Chihuly, *End of Day Persian Pond* (detail), 2022. 6½ x 15 x 12½². © 2023 Chihuly Studio. All rights reserved. Photos by Nathaniel Willson.

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"The drawings have to do with releasing energy. Somebody once said that people become artists because they have a certain kind of energy to release, and that rings true to me." —Chihuly

PREPARING FOR YOUR CHIHULY IN THE GARDEN 2023 VISIT

Registration: All school groups, whether garden-led or selfguided by a teacher, must register their visit to the Garden either online at www.mobot.org or by calling (314) 577-5140.

Chaperones are required. Please observe the following student/chaperone ratio of 1 adult per 5 students. For every 5 students attending a self-guided visit, 1 adult is admitted at no cost. Additional chaperones are admitted at standard admission rates.

The Garden asks that chaperones remain with their assigned group throughout their visit to help the students engage in the field trip in a positive manner.

Divide your Students: Before coming to the Garden, divide students into groups based on the above student/ chaperone ratio. Communicate to your chaperones and students which groups the adults will be assigned to.

Prepare your Students: A successful Garden to experience of *Chihuly in the Garden 2023* starts well before your students arrive. Please acquaint your students with the learning agreements and increase their interest by engaging them in pre-visit activities included in this guide. Students should be informed of 90 minutes to 2 hours in an outdoor setting. Depending on the weather, we recommend bringing refillable water bottles, wearing layers for colder weather, sunscreen, a hat, long pants, and closed-toe shoes suitable for walking outside for extended period of time. Included in this educator guide are multiple pre (and post) activities that can be completed in the classroom. These activities are not required to be completed prior to arrival.

Photography: Visitors to the Garden are welcomed to take photos and shoot videos for personal use. Tripods and monopods will NOT be allowed during the Chihuly exhibit.



Dale Chihuly, *Burnished Amber, Citron, and Teal Chandeliers* (*detail*), 2017. Biltmore, Asheville, North Carolina, installed 2018. © 2023 Chihuly Studio. All rights reserved. Photo by Scott Mitchell Leen.

Student Learning Agreements

- Students will responsibility take care of the plants by walking only in the grass and paved areas while avoiding the planted and mulched beds of the Garden.
- Students are respectful of living plants and encouraged to observe and come into contact with natural items that have naturally already fallen to the ground.
- Students will give respect and dignity to all visitors to the Missouri Botanical Garden.
- Students are invited to be responsible for their own learning through careful observation of the art and living collections.
- Students will speak in a way that is kind, honest, and helpful.

Arriving at the Garden: In order to ensure the best possible experience for your students, chaperones, and drivers, we ask that you review the drop-off and pick up procedures. Depending on general public visitation, car parking for parent chaperones may take place in one the Missouri Botanical Garden overflow lots.

Bus Parking: Please review directions and bus parking guidelines with your driver(s). A copy of "Bus Parking at the Missouri Botanical Garden" is included in this packet. **Please do not unload students until a member of the Missouri Botanical Garden Education team greets your bus.** Bus parking is limited and buses may need to park in the overflow lots. It is encouraged to get your bus drivers contact information prior to entry in the Garden.

Check-in and Admission: Bring your confirmation sheet and present the confirmation to Missouri Botanical Garden Education staff prior to students coming off the bus. Students may then be unloaded and escorted to the Jack C. Taylor Visitor Center by either Missouri Botanical Garden or school personal. Please refrain from dividing your students into groups in the parking lot and inside the Taylor Visitor Center. There is ample room for group separation once you exit the Taylor Visitor Center.

Restrooms and water fountains are located at the front and rear of the Taylor Visitor Center. Water foundations and restrooms are also located throughout the Garden (map included in this packet).

Make sure to arrange and communicate a place to meet when your group is finished. You may wish to gather as a class and discuss your group's experience prior to exiting the Garden.

Departure: Meet your bus in the same area that your group was unloaded. Bus drivers will not be permitted to pick up students in the front steps of the Taylor Visitor Center.

"I want my work to look like it just happened, as if it was made by nature." —Chihuly



Dale Chihuly, *Fiori Boat*, 2018, and *Fiori di Primavera*, 2023, Missouri Botanical Garden, St. Louis, installed 2023. © 2023 Chihuly Studio. All rights reserved. Photo by Nathaniel Willson.

Outside food and drinks are NOT permitted in the Garden.

The Garden offers two suggestions for lunch:

- **Sack lunches** are provided by Catering St. Louis. For a current menu, pricing, and ordering, please call (314) 577-9530.
- Picnic in Tower Grove Park. Call (314) 771–2679 to reserve a pavilion. Tower Grove Park is adjacent to the Garden.

WHO IS DALE CHIHULY?

by Davira S. Taragin, Director of Exhibitions and Programs at Racine Art Museum Adapted from the exhibition catalogue Dale Chihuly 2002, Grounds for Sculpture, Hamilton, New Jersey

Dale Chihuly is most frequently lauded for revolutionizing the Studio Glass movement, by expanding its original premise of the solitary artist working in a studio environment to encompass the notion of collaborative teams and a division of labor within the creative process. However, Chihuly's contribution extends well beyond the boundaries of both this movement and even the field of glass: his achievements have influenced contemporary art in general. Chihuly's practice of using teams has led to the development of complex, multipart sculptures of dramatic beauty that place him in the leadership role of moving blown glass out of the confines of the small, precious object and into the realm of large-scale contemporary sculpture. In fact, Chihuly deserves credit for establishing the blown-glass form as an accepted vehicle for installation and environmental art, beginning in the late twentieth century and continuing today.

A prodigiously prolific artist whose work balances content with an investigation of the material's properties of translucency and transparency, Chihuly began working with glass at a time when reverence for the medium and for technique was paramount. A student of interior design and architecture in the early 1960s, by 1965 he had become captivated by the process of glassblowing. He enrolled in the University of Wisconsin's hot glass program, the first of its kind in the United States, established by Studio Glass movement founder Harvey K. Littleton. After receiving a degree in sculpture, Chihuly was admitted to the ceramics program at the Rhode Island School of Design, only to establish its renowned glass program, turning out a generation of recognized artists.

Influenced by an environment that fostered the blurring of boundaries separating all the arts; as early as 1967 Chihuly was using neon, argon, and blown-glass forms to create room-sized installations of organic, freestanding, plantlike imagery. He brought this interdisciplinary approach to the arts to the legendary Pilchuck School in Stanwood, Washington, which he co founded in 1971 and served as its first artistic director until 1989. Under Chihuly's guidance, Pilchuck has become a gathering place for international artists with diverse backgrounds. His studios, which include an old racing -shell factory in Seattle called The Boathouse and now buildings in the Ballard section of the city and in Tacoma, Washington, have become a mecca for artists, collectors, and museum professionals involved in all media.

Stylistically during the past forty years, Chihuly's sculptures in glass have explored color, line, and assemblage. Although his work ranges from the single vessel to indoor/outdoor site -specific installations, he is best known for his multipart blown compositions. These works fall into the categories of mini environments designed for the tabletop and large, often serialized forms displayed in groupings on pedestals or attached to specially engineered structures that dominate large exterior or interior spaces.

Chihuly and his teams have created a wide vocabulary of blown forms, revisiting and refining earlier shapes while at the same time creating exciting new elements, such as his recent Fiori, all of which demonstrate mastery and understanding of glassblowing techniques. Earlier forms, such as the *Baskets, Seaforms, Ikebana, Venetians*, and *Chandeliers* from the late 1970s through the 1990s, continue to reappear with fresh variations and within new contexts.

Since the early 1980s, all of Chihuly's work has been marked by intense, vibrant color and by subtle linear decoration. At first he achieved patterns by fusing into the surface of his vessels "drawings" composed of prearranged glass threads; he then had his forms blown in optic molds, which created ribbed motifs. He also explored in the *Macchia* series bold, colorful lip wraps that contrasted sharply with the brilliant colors of his vessels. Finally, beginning with the

6 Educator's Guide to Chihuly in the Garden 2023 at the Missouri Botanical Garden

Venetians of the early 1990s, elongated, linear blown forms, a product of the glassblowing process, have become part of his vocabulary, resulting in highly baroque, writhing elements.

Chihuly's work is strongly autobiographical. His fascination with abstracted flower forms, reminiscent for him of his mother's garden in Tacoma, has been discussed in depth in the literature. Likewise, series such as his *Seaforms*, *Niijima Floats*, and even the *Chandeliers* allude to his childhood in Tacoma, marked by his love of the sea and his recognition of its importance to the economy of the Pacific Northwest. Even in the few instances in which the artist has chosen to respond to earlier historical decorative arts forms, the imagery has personal significance. The Basket series, for instance, developed out of the woven Northwest Coast

Indian baskets that Chihuly saw in 1977 with his friend the sculptor Italo Scanga and with the sculptor James Carpenter at the Tacoma Historical Society. Over the years the artist has created a number of memorable installation exhibitions, including *Chihuly Over Venice* (1995–96), *Chihuly in the Light of Jerusalem* 2000 at the Tower of David Museum of the History of Jerusalem (2000), *Chihuly in the Park: A Garden of Glass* at Chicago's Garfield Park Conservatory (2001–2), the *Chihuly Bridge of Glass* in Tacoma (2002), and *Mille Fiori* at the Tacoma Art Museum (2003). These installations confirm the artist's sensitivity to architectural context and his interest in the interplay of natural light on the glass that exploits its translucency and transparency. Recent situations have heightened this effect, since the buildings Chihuly has selected as sites for the works have themselves been of glass.

While elements of the earlier installations allude to natural phenomena such as icicles and vegetation, gardens provide the dominant theme in Chihuly's most recent ones. Sites that include Chicago's Garfield Park Conservatory and the Franklin Park Conservatory in Columbus, Ohio, as well as future projects at the Atlanta Botanical Gardens and Kew Gardens, London, enable the artist to juxtapose monumental, organically shaped sculptural forms with beautiful landscaping, establishing a direct and immediate interaction between nature and art. Moreover, Chihuly's most recent installations at the Tacoma Art Museum and at Marlborough Gallery, New York, reveal the artist's progression toward a logical next direction: installations that are gardens themselves. In a sense, Chihuly has come full circle; now using his mature vocabulary, he captures in these installations the *joie de vivre* of the plantlike forms of his early neon environments.

A dominant presence in the art world, Dale Chihuly and his work has long provoked considerable controversy as part of the art/craft debate. However, with exhibitions at such major museum venues as the Victoria and Albert in London (2001), there can be little doubt that his lasting contribution to art of our times is an established fact.



Defining Principles of Dale Chihuly's Work

- Teamwork is essential to the production of Chihuly's glass and sculpture
- Breaks boundaries by taking glass outdoors with large scale sitespecific exhibitions
- Produces artwork in series
- Uses fire, gravity, heat and centrifugal force as his main tools to shape glass
- Pushes the limits of glass by applying new technical discoveries
- Vibrant colors
- Influences: Organic forms, Native American Art

CHIHULY'S ARTWORK



Blanket Cylinders, 1995



Tabac Basket Set with Black



Blue Appeal Seaform Set with Astral White Lip Wraps, 2003



Pumpkin Macchia with Olive Lip Wrap, 1982

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Cylinders (1975)

"In 1974 we came up with a way to pull colored glass rods into long, thin threads. This allowed us to make drawings out of glass that we could then pick up onto the outside of a gather of glass. We knew right away that drawing on glass was a breakthrough idea..." —Chihuly

Over the course of his career, Chihuly has produced four series based on the cylinder form: Blanket Cylinders (1975, 1976, 1984, 1995), Irish Cylinders Jerusalem Cylinders (1999), and Soft Cylinders (1988)

Baskets (1977)

Native American woven baskets, with their simple lines and soft, uneven forms were the inspiration for this early series. Begun in 1977, the artist recognized that he could create new shapes and form s by accepting the effects of gravity. Delicate and asymmetrical, the Baskets are sometimes surrounded by glass threads wrapped around the outside, which provide color and texture. The Basket series was the first where Chihuly used a "lip wrap", a contrasting color to delineate the edge of the vessel.

"I had seen some beautiful Indian baskets at the Washington State Historical Society, and I was struck by the grace of their slumped, sagging forms. I wanted to capture this in glass. The breakthrough for me was recognizing that heat and gravity were the tools to be used to make these forms." —Chihuly

Seaforms (1980)

"The Seaforms seemed to come about by accident, as much of my work does by chance. We were experimenting with some ribbed molds when I was doing the Basket series. By blowing the pieces into ribbed molds, it gave them more strength. It's sort of like corrugated cardboard—or actually, like sea shells themselves, which are very often ribbed. Then the Baskets started looking like sea forms, so I changed the name of the series to Seaforms, which suited me just fine in that I love to walk along the beach and go to the ocean. And glass itself, of course, is so much like water. If you let it go on its own, it almost ends up looking like something that came from the sea." —Chihuly

Macchia (1981)

The *Macchia* series developed from the artist's desire to explore different color combinations, eventually using all 300 colors of glass available. Each work is speckled with color which comes from rolling the molten glass in smaller shards of colored glass during the blowing process. Notice the interior and exteriors are different; they are separated by a layer of white opaque glass. *Macchias* are often installed together on pedestals in groupings called "Macchia Forests".



Rose Madder Macchia with Yellow Lip Wrap, 1986



Blue and Pink Persian with Bright Blue Lip Wrap, 1987



Venetian



Blarney Gilded Green Ikebana with Two Stems, 2000

"I had called my friend Italo Scanga, because they were doing this catalog of my work and I said, "Italo, I've got to have a name for this new series, these brightly spotted pieces. I think I'm going to call them the Spotted series." (My mother was calling them the "Uglies.") He said, "No, that's a terrible name." And I said, "How do you say spotted in Italian?" He's from Italy and he said, "I can't remember. Let me go look it up and I'll call you back." He called me back and said "Macchia. Macchia, that's a great name." So I call it the "Macchia" series, which is 'spotted' in Italian. I still do some of the kind of transparent pieces, a holdover from the seaform shapes. Those Macchia pieces remind me of the sea, the deep sea, too." —Chihuly

Persians (1986)

This series' title hints at associations with ancient glass styles and reflects the fusion of East and West. Historically, Venice has shown an assimilation of Persian, Byzantine and eastern ideas. When Chihuly worked at the Venini factory in Venice, he became aware of these historical ties and stylistic influences in Venetian art. Persians, with their gently fluted edges, are delicate yet powerful, and their jewel-like colors and sensuous curving forms make them some of Chihuly's most glorious works.

"The Persians started out as a search for new forms. I set up Martin Blank and Robbie Miller in a corner of the hotshop at Pilchuck. I would make large pencil drawings for them with a couple of dozen small forms, and then I would put an X under the ones I wanted them to go for. Over the next year, we made more than 1,000 miniature experimental forms." —Chihuly

Venetians (1988)

"Lino Tagliapietra and I decided to try to do something together. I began by designing a series that was a takeoff on Venetian Art Deco pieces from the 1920s. I was able to sketch them, and from these images Lino began to blow...

We had a great time putting these together—always going further, pushing beyond what we had done in each previous piece. Handles changed to knots, prunts became claws, colors went from subtle to bright, and forms from symmetrical to asymmetrical." —Chihuly

lkebana (1989)

"I took my Venetians and added long-stemmed glass flowers and leaves, which evolved into my Ikebana series. I started calling them Ikebana partly because I had just been to Japan. The quintessential Ikebana would be a base piece with a long stem coming out of it, perhaps two or three stems. And it might be six feet high." —Chihuly



Gilded Putti with Cobalt Turquoise Leaves, 1995



Niijima Floats, 2003 Franklin Park Conservatory



V&A Chandelier, 2001 Victoria and Albert Museum

Putti (1989)

Putto is the Italian word for "little boy". Putti (poo'tee) is the plural form. Putti figures are seen often in Renaissance and Baroque art as chubby winged creatures. Today, we associate this character with Cupid, the Roman god of love.

"I don't really quite remember how the Putti idea came. I was up at Pilchuck, and I conspired to get Pino Signoretto and Lino Tagliapietra to work together on the same piece—something that simply would never happen in Murano. So I made a design that Lino would blow, and Pino would make the Putti, and we would put them together... all these different ways that the Putti could look, sit, and play."—Chihuly

Niijima Floats (1991)

These large glass spheres reminded Chihuly of the fishing floats he used to find as a boy in the Pacific Northwest. Niijimi is an island in Japan where there is a renowned glass center.

"On the tiny island of Niijima, way out in Tokyo Bay (an overnight boat trip), Osamu and Yumiko Noda, former students at Pilchuck, created a glass school perched on a cliff looking out to sea. It was there in 1991 that I started my series NIIJIMA FLOATS-orbs, darkly colored, and amongst the largest freeblown forms ever. Named for both the island and the traditional Japanese fishing floats, my "floats" kept reminding me about the oceans and the oceans' currents. So, after much discussion, we went back to Niijima in 1997 to experiment with forms-and the sea. Using the local glass made from beach sand, I made variants of the Japanese floats-in my bright colors, of courseand we installed them at the beach and all around the island. We even tried to put them out to sea. Not so easy, and, it turns out that there are literally millions of fishing floats still in the Pacific caught in the trade currents, going round and round. No wonder finding one on the beach is such good luck." —Chihuly

Chandeliers (1992)

Chihuly started his *Chandelier* series in 1992. A feat of engineering to install, these *Chandeliers* can be up to 27 feet long, be comprised of more than 1300 pieces of glass and weigh thousands of pounds! Attached to an internal steel armature, each part is a striking work of art by itself, whether it is round and bulbous or long and curving. Although a *Chandelier* is not lit from within, the pieces create an intricate composition of color and light.

"What makes the Chandeliers work for me is the massing of color. If you take hundreds or thousands of blown pieces of one color, put them together, and then shoot light through them, now that's going to be something to look at! When you hang it in space, it becomes mysterious, defying gravity, becoming something you have never seen before." —Chihuly



Citron Green and Red Tower, 1998 -Fairchild Tropical Botanic Garden



Carnival Boat, 2005 Fairchild Tropical Botanic Garden



Desert House Red Reeds, 2001 -Garfield Park Conservatory



Blue Herons, 2005 Royal Botanic Gardens, Kew

Towers

After the *Chihuly Over Venice* project in 1995-1996, Chihuly realized he could make a completely new type of sculpture by turning his Chandeliers upside down! Constructed from hundred of pieces of glass attached to a steel base support, *Towers* allow Chihuly to install large dramatic sculptures in spaces that would not support the weight of a Chandelier. Like the *vv*, a Tower's glass pieces are many different lengths and shapes that project outward, creating vibrating waves of color and light.

"The idea of a Tower just came from looking at one of my Chandeliers and imagining what it would look like upside down." —Chihuly

Boats (1995)

Chihuly first filled boats with glass in Nuutajärvi, Finland, during the *Chihuly Over Venice* project in 1995-1996. After several days of glassblowing, Chihuly and the team made temporary installations along the Nuutajoki, the river nearby. He often tossed glass into the river, letting it float downstream. Local kids in small wooden rowboats gathered them, and it was probably then that Chihuly saw the opportunity for a new type of installation. When the team found a partially submerged wooden rowboat, which was hauled out and emptied of mud and debris, Chihuly filled it to overflowing with glass. He has continued to revisit the "Boat" idea ever since.

Reeds (1995)

To make the *Reeds*, one glassblower holds the gather of glass on the blowpipe, climbs into a mechanical lift, and blows into the glass while another person on the ground pulls it from below. Some are longer than 10 feet!

"In Finland we started making these long, cylindrical pieces that looked like spears. This was an exciting new form. It was the first time we ever made anything like that. Sometimes I call them spears and sometimes I call them reeds. They can be taken anywhere—they can go outside. They are very strong pieces, and they are very dramatic." —Chihuly

Herons

Herons, shaped like wading birds, evolved from Chihuly's experimentation with blowing different shapes and using new techniques in Finland. After making the *Reeds*, he continued to push his team to try new things with the elongated tube form. After many days, they made pieces that looked to them like *Herons*, which are wading birds found along shorelines and lakes. Chihuly often names his glass parts after words he uses with his glass blowers as they attempt to describe the shapes they created through experimentation.



Chihuly Bridge of Glass, Crystal Towers, 2002 Tacoma, WA



Brilliant Pink Fruit Pavilion Tumbleweed, 2005



Walla Wallas, 1996 Seattle, WA

Polyvitro crystals

Made from a polyurethane material, the *Polyvitro Crystals* are large and hollow. The lighter material allows greater scale, as seen in the Glass in the Garden installation in the Latzer Fountain. Chihuly first used *Polyvitro Crystals* in the *Crystal Mountain*, a sculpture created for the Chihuly exhibition in the Light of Jerusalem 2000. The Crystal Tower elements are raw, brutal forms, monumental and bold, that appear as if cut from mountain peaks or taken from frozen alpine lakes.

"The crystals are hollow and glacial blue in color. As with glass, it is really light that makes the Polyvitro crystals come alive." —Chihuly

Neon Tumbleweeds

Chihuly worked with neon early in his career. He first made tumbleweeds in 1993 and in 2005 began working with this form again.

"After remaking 20,000 POUNDS OF ICE AND NEON for the opening at the Seattle Art Museum, I decided to experiment. Thinking about making a neon "drawing" in the ice, where else do you turn but to an ice rink. So, I approached my hometown rink at the Tacoma Dome for permission to run the test, and permission was granted. However, the local newspaper heard about it and editorialized that my "experiment" should be open to the public, and so finally it was. Open to the public, yes; an experiment, no. After all, I could not fail the folks of my hometown.

We created a spectacle of one hundred thousand pounds of ice in threehundred-pound blocks with neon of all colors frozen inside, complemented with seven neon tumbleweeds, and an ice-skater to top it all off. Thirty-three thousand people came through that weekend, lots of families came back three or four times, and it made me realize just how interested peopleeveryday people-are in seeing art and how very much it can mean to children." —Chihuly

Walla Walla Onions

These glass pieces with pointed tips resemble their namesake, the famous sweet onions of eastern Washington State.

A BRIEF HISTORY OF GLASS

The beginnings: Archaeological findings indicate that Stone Age man used naturally formed glass in his everyday activities. Obsidian (from volcanic origins) and tektite (from meteoric origins) were used for cutting, cleaning animal skins, as weapon points, etc.

Pliny, the ancient Roman historian, recorded that man became aware of produced glass probably about 5000 BC in Syria. This glass resulted from the building of very hot fires on nitrate surfaces and the heat from the fire eventually melting the nitrate into a primitive glass substance.



Glass Broach Carthage, 4BC, 1.5"

3500 BC: Glass beads seem to be the first objects made from glass around 3500 BC in Egypt and Mesopotamia. At the same time glass was being used as a glaze on ceramic ware.

1700 BC: Around 1700 BC the first hollow glass forms were made; although the actual process is not known for certain.

1500 BC: About this time Egyptian glassmakers made hollow glass forms by dipping a core mould made from compacted sand into molten glass which coated the mould. The outside was smoothed out while the glass was still molten. The sand core was removed after the glass had cooled. Pharaoh Tuthmosis III (1504 -1450 BC) brought glassmakers to Egypt as prisoners from conquered lands and had them make glassware some of which bore his name.



Roman Glass, 10BC

650 BC: Little changed in the making of glassware but clay tablets written about 650 BC and found in the library of the Assyrian King Ashurbanipal recorded instructions for making glass.

25 BC: About 25 BC a major breakthrough in glass production, glass blowing, was introduced by Syrian craftsmen. The process of glass blowing involves placing glob of molten glass on the end of a metal tube through which the glass maker would blow and produce a hollow form with his breath. The Romans took the process farther by blowing the glass into moulds.

100 AD: About this time clear glass for windows is first made, although it was a far way from what we expect in clear glass. Often their "clear" glass was more translucent than clear and had many imperfections. At this time Alexandria and Koln in the Rhineland were the major production areas for glass.

1000: Potash from burnt trees was replaced in many areas for soda as the main ingredient. This made glass ingredients more readily available and spurned the production of glass in many areas.

1100: Glass sheets became more available through the process of blowing glass forms and then flattening them. These pieces of flat glass were limited in size so they were joined together using lead strips. Glass windows though were very expensive and you would most likely find them in palaces and churches. Stained (colored) glass came to its peak at this time and many magnificent examples can be found in cathedrals built during this time.



Stained Glass Window, 12C

1271: Venice, as a major trading center at this time, gathered many of the skills, techniques and materials about glass making. It became a major producer of glass, but, because of the frequency of fires from the numerous glass furnaces, the government ordered the glassmakers to the island of Murano which is still famous for its quality glass production today.

1400: Murano started using quartz sand and potash to create a purer and clearer glass.

1674: George Ravensdcroft substituted lead oxide for some of the potash in glass and produced a brilliant and highly reflective glass called lead crystal. This glass was also well suited for deep cutting and engraving.

1688: France discovers the process of pouring molten glass on to special tables to produce a uniform thin piece of glass which after polishing made for a better quality plate (flat) glass. They also coated some of the glass with a low temperature metal and produced mirrors.

1875: Otto Schott and Ernst Abbe use scientific methods to study the effects of various chemicals in glass and produce a superior optical and thermal glass. Along with Carl Zeiss they develop a leading firm in producing quality optics that still exists today.

About the same time Michael Owens invents an automatic bottle blowing machine and along with E.D.L. Libby revolutionizes the mass production of glass containers.

Tiffany Glass, 20C

Decorative art glass became popular about this time with famous names like Tiffany and Stueben producing creative and decorative tableware and sculpture.

1910: Safety glass, found in all cars today, is introduced. By sandwiching a clear plastic between two layers of glass, the glass might crack but will not shatter making glass a lot safer.

1915: Emil Bicheroux of Belgium invents the process of pouring molten glass directly onto metal rollers that press the glass into more even plate glass which requires less polishing.

1928: Pittsburg Plate Glass Company further refines plate glass production that is still in use today.

1959: Pilkerson Brothers Limited of England invents the float process for producing plate glass. Molten glass is poured over a surface of molten tin. The glass spreads and flattens with a brilliant surface.

By this time little hand blown glass was produced outside of large factories because of the cost. Harvey Littleton and Dominic Labino developed a furnace and a glass formula that would greatly reduced costs and therefore could be used in smaller studios. Artists quickly grabbed up the potential of private studio glass production and modern art glass quickly blossomed.

Frank Lloyd Wright

Today: Glass today is not finished evolving. Computer control, special coatings, refractory glass, micro-electronics, and creative innovations promise all kinds of potential for glass and the future.







SCIENCE OF GLASS

from the Kalamazoo Institute of Arts, Chihuly in Kalamzoo—A Resource Guide for Educators

What is Glass?

Glass is typically made from three types of materials: formers, fluxes and stabilizers. **Formers** are the main ingredient, making up the largest portion of the mixture. The silica found in sand or quartz is the most common former. **Fluxes** lower the temperature at which the Former will melt. Soda ash (sodium carbonate) and potash (potassium carbonate) are the common fluxes. **Stabilizers** combine with the formers and fluxes to keep the finished glass from crumbling or falling apart. Calcium carbonate (lime) is the most frequently used stabilizer.

These three ingredients are mixed together in a tank and heated at high temperature (around 2300°Fahrenheit until the mixture reaches the consistency of honey). This mixture is called a batch. At this point, the molten glass can be cast, blown or shaped.

Batch of Glass = Former (sand) + Flux (ash) + Stabilizer (lime) + Heat (2100-2300°F)

Liquid or Solid?

Glass is a unique substance. It is a homogeneous material with a random, non-crystalline (liquid-like) molecular structure. When it is cool, it is hard, yet breakable because it does not have the crystalline molecular structure required for a solid. Glass is categorized as the fourth state of matter. This vitreous or "glassy state" combines the rigidity of crystals with the random molecular structure of liquids. In other words, cooled glass is rigid like a solid but its random atomic structure is characteristic of a liquid.

Glasses also differ from crystalline solids in that they do not have distinct melting points. Since the bonds in glass are irregular, they break over a range of temperatures when it is heated. As the bonds break, the glass becomes more viscous (liquid) and workable. **Working Point** is the level of viscosity at which the glass is suitable for shaping and forming.

Properties of Glass

- Mechanical: Glass is strong and hard but elastic.
- Chemical: It is corrosion resistant, meaning that it is affected by few chemicals and resists most acids.
- Thermal: Modified glass can withstand intense heat or cold, as well as sudden temperature changes. It also absorbs heat and retains it rather than conduct it.
- Optical: It can reflect, bend, transmit and absorb light.
- Electrical: Glass strongly resists electric current (insulating) and it stores electricity efficiently.

How is glass colored?

The basic process described above produces clear glass. To make colored glass, metal oxides must be added to the batch. The following oxides produce the following colors:

Copper	Turquoise	Cobalt	Blue
Manganese	Purple	Cadmium/Gold	Ruby Red
Chrome	Green	Uranium	Yellow

THE ART OF GLASSBLOWING

provided by George Gasparich

The Ingredients

Although there are many variations in the formula, all glass is basically composed of the same ingredients. **Silica** is the main glass element, a **fluxing** agent is used to lower the melting point of the silica, and (if desired) a coloring **metallic oxide** is added. White sand is most commonly used as a source for silica because of its abundance and relative low cost. The fluxing agents are usually lead, borax, pearlash, or soda. All kinds of metallic oxides have been used to create colored glass. Iron oxide tends to change glass to a greenish hue; manganese causes a clear or (if more

is added) purple tint; cobalt creates a blue color; copper or gold a red; silver a yellow; and tin a white colored glass. These three elements of glass- silica, a fluxing agent and a metal oxide- need to be in a powder form before they are mixed and placed into a calcining **furnace**. In this furnace they are heated, mixed and purified for five to six hours. The resulting mixture is called a **batch** and is heated to 2,150°F. Batches may be made in amounts as small as a few pounds or weighing hundreds of pounds. When the glass is at the right stage it is ready for the craftsman.

The Process

There are many techniques that can be used to make glass. With the currently available technology, many types of glass- such as plate (flat) glass, everyday glassware, and glass jarsare mass produced by machines. Many of these items are never touched by human hands. Glassblowing, however, is still done by hand.



Marvering



Gloryhole

In glassblowing the process of creating a piece of glassware or glass sculpture is controlled by the artist using various techniques and tools. The glassblower first picks up a **gather** of glass on the end of his metal **blowpipe**. With the gather of glass on the end of the blowpipe the glassblower blows in the opposite end of the tube and forms a bubble of

air in the gather. The craftsman turns the blowpipe while blowing to help keep the developing form symmetrical. If the glass becomes too cool to work with the piece is reheated in another furnace called a **gloryhole**. The glass can also be reheated using a blowtorch. The glassblower continues to blow on the pipe as he or she fully develops the form of the piece.

A variety of tools and processes can be used in the development of blown glass. **Marvering** is the process of rounding and evening out the form using a **marvering table** or paddles. When the lip or open

end of the piece needs to be developed, the glass is transferred to a **pontil** rod. This tool is attached to the bottom of the glass which is then removed from the blowpipe. Now the lip is free to be shaped and decorated. Tools such as **shears**, pliers and forceps can be used to cut, bend, and stretch the glass as needed. A rim, foot, handle, spout, etc. can be fused onto the main piece using other glass pieces. Decoration can be added with the use of other glass forms, glass rods, and glass chips (**jimmies**). When the creation is completed, it needs to cool slowly to avoid thermal shock. This is done in an **annealing** furnace; initially set at 900°F this furnace will slowly cool the glass over a 12 hour period.



Lip Work



Blowing Glass

EDUCATIONAL ACTIVITIES: K–2

Pre-Visit Activity: Who is an Artist?

- Inform the students that soon they will be traveling to the Missouri Botanical Garden to view the Garden's plants and a special art exhibition that was created by an artist named Dale Chihuly
 - To help students understand what they will be seeing during their trip to the Garden, provide students access to view various pieces of his previous designs.
 - A great resource to utilize when showing various designs is the website www.chihuly.com.
 - Once students have had the ability to see a few of the glass pieces that Chihuly has created, provide the students with age appropriate information about the artist.
 - Dale Chihuly is an American glass artist who oversees the creation of blown glass into a large sculpture representing natural elements.
 - Fascination with abstracted flower forms.
- Allow students time to brainstorm potential characteristics of an artist.
 - Create a list of student responses on the classroom white board.
 - Characteristics of an artist include: uses their imagination, creates and designs with many tools, shares their art with others, focused on their work.
 - Ask students if all of these characteristics listed are needed to be an artist?
 - Ask students if they are an artist?
 - Ask what characteristics the students have that show they are an artist.
 - Passionately state that they are an artist and everyone can be an artist.
- Invite students to create an art notebook. An art notebook can be a collection of papers stapled together in book form.
 - In the first page of the student art notebook, invite the students to draw themselves as an artist.
 - Encourage students to use their imaginations to create themselves as artists at their favorite space (in school, at home, etc.).
 - Allow students free time and access to materials to create a picture of themselves as an artist.



Dale Chihuly, *Russet Yellow Paintbrush Ikebana*, 2006. Atlanta Botanical Garden, installed 2016.© 2023 Chihuly Studio. All rights reserved. Photo by Scott Mitchell Leen.

- Pencils
- Markers
- Crayons
- Colored pencils
- Paper
- Access to internet to view artwork designed by Chihuly

Pre-Visit Activity: Schoolyard Glass Scavenger Hunt

• Inform students that they will be visiting the Missouri Botanical Garden to see the plants and an art display created by Dale Chihuly

- Chihuly is famous for his creations of glass figures that take the shape of forms seen in nature.
- However, this not the only place that we can see glass. Glass is all around us.
 - Inform students that the history of glass can go back many thousands of years.
 - The materials to create glass has been the same throughout this time. To make glass, you use fire to melt sand into a liquid stream that is then cooled to create glass.
 - View the sort PBS Cat in the Hat clip entitled *How Glass is Made.*

• To demonstrate that glass is all around us, invite the students to conduct a glass scavenger hunt either in their classroom or school in pairs or as individuals.

- During the scavenger hunt invite students to make a list of the things that they find that is made of glass.
- After their list has been created, challenge the students to draw and label a few of the items that they are seeing.
- As a whole group, invite students to share what observations they made during their scavenger hunt.
 - When students mention a piece of glass, write the student response on the board ensuring all pieces of glass mentioned is included.
 - If age appropriate, lead the students in a discussion about what is similar, different and/or commonly found through our observations.
 - Challenge the students to think how these items can be grouped together. Grouping ideas could be color, function, size, etc.



Polyvitro Crystal Tower, Missouri Botanical Garden, 2006

- Access to computer and projector to play PBS Cat in the Hat clip entitled How Glass is Made
- Paper
- Pencil
- Whiteboard

Pre-Visit Activity: Exploring Color

- Inform students that they will be visiting the Missouri Botanical Garden to see the plants and an art display created by Dale Chihuly.
 - Chihuly is famous for his creations of glass figures that take the shape of forms seen in nature.
 - Many of these pieces have multiple colors used throughout the pieces.
 - Ask students to name their favorite color.
 - Teacher can record student responses to create a graph to show the classes favorite colors.
 - To introduce colors to the students, show students the The Rainbow Song | Kids Songs | Super Simple Songs on YouTube (2:39).
 - At the conclusion of the song, ask the students to observe their surroundings. What colors are they seeing in the classroom?
 - Are their any colors in the rainbow song that you do see in your classroom? Why or why not?
 - Ask students if the colors in the song are the only colors they know? Do we see any other colors in our classroom that are not in the rainbow?
 - Color is used in a way that can make us feel good, show-case emotion or a mood.
 - Ask students to identify a feeling they currently have and think of a color that represents that feeling.
 - Some students may not feel comfortable sharing.
 - Project an mages from various pieces that Dale Chihuly has created.
 - Ask the students while looking at the picture, what colors are they seeing?
 - Are any of the colors in the piece more visible than others?
 - Repeat the above process with additional pieces.
 - Ask students which colors do you think the artist likes to use the most.



Dale Chihuly, *Summer Sun (detail)*, 2010. Denver Botanic Gardens, installed 2014. © 2023 Chihuly Studio. All rights reserved. Photo by Scott Mitchell Leen.

- Access to computer and projector to show Chihuly pieces
- Whiteboard/Markers

Post-Visit Activity: Exploring Color

- Back at school, invite the students to share some of their favorite flowers or glass pieces that they have seen.
 - As the students are sharing their favorite sights, ask students if they can remember what color the object or flower was.
 - As students mention a color, write down what the students responses are on the white board.
 - Discuss with students any color themes that can be noticed based on student responses. Are the students liking blues more than reds, reds more than yellows, etc.
 - Ask students to hypothesis what would happen if we mixed two of our favorite colors together?
 - If able, secure watercolor paper, a water cup, paint brush, watercolor paints and pencil for each student or group of students.
 - Refer students to the colors that they previously mentioned.
 - Invite students mix different colors together to see if they can create a color mentioned that is not in their paint tray.
 - Have students write in a notebook which colors they are mixing and what new color is being created.
 - Were you able to create the color you were looking for?
 - If working with older students, invite the students to mix two primary colors together to make a secondary color.
 - Invite students to write what color was created when mixing the two colors?
 - Mix a secondary color with a primary color.
 - Invite students to write what color was created when mixing the two colors?



Dale Chihuly, Imperial Blue Ikebana with Green Frog Foot Stems, 2002. Atlanta Botanical Garden, installed 2016. © 2023 Chihuly Studio. All rights reserved. Photo by Scott Mitchell Leen.

- Watercolor paper
- Water cup
- Paintbrush
- Watercolorpaints
- Pencil
- Paper/notebook

Post-Visit Activity: K-W-L Chart

- Create a K-W-L chart on the whiteboard, interactive board, chart paper, or overhead.
- Using a blank piece of paper, have the students fold the paper into three columns.
 - Students can then write the appropriate headings.
 - "K" what I know "W" what I wonder "L" what I learned.
 - Students can record on their individual charts under the K column words or ideas that stood out to them when discussing the Chihuly exhibit at the Missouri Botanical Garden.
 - Three to five is a good goal for students.
 - Example: Colors can be used to draw attention.
 - After students have had some time on their own, ask them to come back to the class and share their knowledge.
 - Record under the K column on the class K-W-L chart.
 - Example: Colors can be used to draw attention.
 - Ask students to record three to five questions that they might have about the topic on their individual K-W-L chart in the W column.
 - Record under the K column on the class K-W-L chart.
 - Example: How hot does sand have to be to become liquid?
 - Next use the L column on their individual charts to record any new information learned during this experience.
 - Example: glass is made from sand.
 - Questions that are unanswered may be answered by further research from students.



Dale Chihuly, *Ethereal Spring Persians*, 2022. Missouri Botanical Garden, St. Louis, installed 2023. © 2023 Chihuly Studio. All rights reserved. Photo by Nathaniel Willson.

- Paper
- Pencil
- Projector
- Teacher copy of K-W-L chart

EDUCATIONAL ACTIVITIES: 3–5

Pre-Visit Activity

- Prior to arrive at the Missouri Botanical Garden to visit the Chihuly in the Garden display, take time to explain a few key facts about glass to students. Ideas to share with students include:
 - Glass never wears out; it can be reused and repurposed forever.
 - Glass is made from sand. Mixing lime and soda ash with sand at extreme heats causes sand to turn into a liquid. As this cools, the result is glass.
 - Glass can be made in nature. When lightning strikes sand, the heat from the lighting can fuse sand into long, slender glass tubes. These tubes are called fulgurites.

- Pencils
- Markers
- Crayons
- Colored pencils
- Paper
- Recyclable materials
- Access to internet to view artwork designed by Chihuly
- Images displayed showing various Chihuly works
- Adding minerals to the sand, soda ash and lime mixture can result in different colored glass.
- Explain to students that Chihuly designs artwork in a series and utilizes many members of his team to produce the sculptures you will soon see.
 - Show students a wide variety of Chihuly sculptures that have been designed in the past.
 - Explain that each of the objects are arranged in a special way to represent themes from nature.
 - They also feature many shapes.
 - Ask students to identify the different natural features they see in the different sculptures.
 - Ask students to identify the many different shapes that they are seeing in the sculptures?
 - Remind students that many of these pieces were created by many individuals with many different talents. Ask the students if they have ever created something that took the work of a team to accomplish.
 - With students in groups of two to three students, invite the students to create a sculpture using scrap pieces of paper and other recyclable materials found throughout the school.
 - Have students glue or tape the pieces together.
 - Challenge the students to create the sculpture in the style of something that they can find in nature.
 - Invite students to compare the many different designs that the students had created.
 - Are there similarities to the designs?
 - Questions could include: did groups use the same of different shape, materials, styles?

Pre-Visit Activity: Exploring Chihuly's Creative Process

- Dale Chihuly has said that his drawings have to do with releasing energy. He draws with broad, free gestures to capture the essence of his thoughts.
 - Explore shapes with fluidity. Have your students select a simple shape or form that appeals to them.
 - Shapes are flat in appearance due to their twodimensionality, and they are usually described as "enclosed" lines. For example, a square is made of four lines and a circle is an enclosed curved line, and so forth.
 - Shapes are often described in terms of being building blocks; we can start an artwork by first drawing the main shapes that will be needed and expanded on.
 - It is important to become familiar with how shapes give shape to the objects and environment around us.
 - Ask students to state shapes they see in the classroom. Further challenge students to name shapes found in nature (a tree for example).
 - Have students quickly draw as many versions of that object as possible within three minutes on a piece of paper.
 - They should concentrate on rendering shapes without details.
 - At the end of the three minutes, have each student select one of their images to take to the next step.
 - Allow students to add fluidity into the shape.
 - Inform students that a fluid shape is one that does not possess a definite shape.
 - Provide students with a few image examples of designs that have fluid shapes.
 - Using the shape that the students previously chose, invite students to spend a few minutes creating that shape with no defined boundaries.
 - Provide students with one (or more) following journaling prompts:
 - Was it new or uncomfortable for you? What did you notice as you made more and more drawings? How did they change? How did you change? What intrigued you about the shape? How did it change as you continued to draw it?



Chihuly Bridge of Glass, Seaform Pavilion, 2002 - Tacoma, WA

- Pencils
- Paper
- Projector

Post-Visit Activity

- While visiting the Missouri Botanical Garden, students may not have realized that Dale Chihuly and his team choose locations in which to create their installations.
- As part of this post visit activity, students are going to create a recycled art project in the style of Dale Chihuly.
 - Teacher will scout locations for a class installation on the school grounds (indoors or outdoors) that is a suitable place for student artwork.
 - Divide students into student groups of 3-4 students per group.
 - Invite students to see the site and as a group inform students that they are to design a sculpture like the ones we just seen in this space.
 - Ask student groups to brainstorm ways that they can create a shape that will fit into the environment that the teacher has chosen.
 - Inform students of any size requirements or material limitations at this time.
 - Let students work together create the shape on paper.
 - Once the shape has been created, allow students access to a variety of recycled materials to create their drawing.
 - Using recycled plastic bottles, students can create a variety of forms. Leave the spout of the bottle untouched to use as a way to attach the forms to a larger structure.
 - Students can add tin foil or plastic wrap to elongate the bottle shape and add additional shape armatures. Coat the form with the medium of your choice, depending on indoor or outdoor installation: decoupage, tissue paper/starch, paint, colored plastic wrap, other recycled materials, drinking straws, plastic bottles with the bottoms cut off, plastic wrap, cardboard tubes, foam balls, packing materials, bubble wrap, etc.
 - Students could cut the materials with scissors shaping the plastic into flower or plant-like shapes by layering different material.



Dale Chihuly, *Fiori Boat*, 2018. Cheekwood Estate & Gardens, Nashville, installed 2020. © 2023 Chihuly Studio. All rights reserved. Photo by Scott Mitchell Leen.

- Paper
- Pencils
- Access to a variety of recyclable materials

Post-Visit Activity

- After visiting the Missouri Botanical Garden, students may be wondering more about who Dale Chihuly is and how are the glass sculptures created by Chihuly and his team.
 - A short YouTube video from the Virginia Museum of Fine Arts entitled Dale Chihuly: Playing with Fire (3:55) provides a look into the process.
- After watching the video, invite students to create their own sculptures in the style of Dale Chihuly.
 - Inform students that we will not be creating glass; however we will be creating art that can resemble the coloring process of glass.
 - Provide each student with a piece of newspaper or other table protecting covering and lay this on their desk.
 - Next, provide each student with a clean coffee filter that can be spread out over the newspaper.
 - Provide students with a washable color marker to design their own coffee filter.
 - Let the students know that their design does not have to be perfect, water will make the colors run together.
 - As the students design their coffee filters, provide each student with a a rubber band, plastic plate and plastic cup.
 - After the students finish designing their coffee filter, invite the students to wrap your coffee filter around a plastic cup with the opening of the cup facing down.
 - Use the rubber band to secure the coffee filter in place over the cup.
 - With the coffee filter over the plastic cup tell the students to place the cup on the plastic plate.
 - Teacher can visit each student and spray the coffee filter with a spray starch. Any excess water caught in the plate can be re-poured onto the coffee filter.
 - Place filter still secured to the cup in place to dry.
 - Once dry, remove rubber band.
 - The final product should have a vibrant color resembling the flowers seen at the Missouri Botanical Garden.

Need to make beforehand: Homemade Spray Starch Recipe—Mix together 2 ½ cups of tap water and 1 ½ tbsp cornstarch in a saucepan (make sure there are no lumps). Bring the mixture to a BOIL for 1 minute, then cool to room temperature. Fill a spray bottle.



Blue Herons, 2005 Royal Botanic Gardens, Kew

- Tablecloth or newspaper
- Coffee filters
- Rubber bands
- Plastic cups
- Plastic plates
- Washable color markers

EDUCATIONAL ACTIVITIES: 6–8

Pre-Visit Activity

• Dale Chihuly is an American glass artist that has pieces on display at the Missouri Botanical Garden. In the coming days, inform the class that they will be visiting the Garden to view Chihuly's artwork.

- In designing his sculptures, Chihuly often takes inspiration from the natural environment.
 - Many of his pieces are a form of abstract art. Abstract art is art that does not attempt to represent reality but seeks to achieve its effect sing shapes, forms, colors and textures.
- Provide students will access to view Chihuly's artwork that can be found throughout the world.
 - After looking at some of these pieces, challenge students to note what natural elements influenced his pieces.
 - Challenge students to look at two different Chihuly pieces and think about the similarities of the pieces and difference.
 - A Venn diagram is a good tool to use when discussing similarities and differences.
- Invite the students to create their own abstract piece of artwork using trees (or any other natural element) as their element.
 - Select a large piece of paper as a base.
 - Have students create 20 lines on their papers with a black pencil, marker or crayon. These lines should be very intentional about what it is they are drawing.
 - Invite colors to add colors in random sections wherever they desire.
 - This can be with a different material or a similar material than that of the black lines.
 - Students can cut organic shapes from colored pieces of paper or through the use of pencils, paint, oil pastels, charcoals.
- As students are working on their own abstract piece of artwork, ask the following questions:
 - Describe why you chose the colors that you did.
 - Which colors are illuminating your work.
 - What does the image tell you about your feelings of the natural environment.

- Paper
- Pencils
- Markers, crayons, watercolors, etc.
- Computer access to Chihuly pieces

Pre-Visit Activity

- Dale Chihuly started making *Chandeliers* in 1992 for an exhibition at the Seattle Art Museum. The *Chandeliers* have evolved over the years and may now include thousands of pieces joined together.
 - Chihuly realized that if he turned the Chandeliers over he would be able to stand the sculpture up rather than hang it from a ceiling. These floor based forms he called Towers.
 - *Chandeliers* and *Towers* are built upon a very elaborate steel armature upon which the glass forms are attached. His tallest Tower so far is 55 feet high. His *Towers* and *Chandeliers* can weigh thousands of pounds.
 - Discuss with students that Dale Chihuly is an artist and what they will be experiencing when they visit the Missouri Botanical Garden.
 - Let students research, study, discuss and make some decisions about size, color, forms, attaching techniques, etc. about their sculpture.
 - As a way to create the sculpture, paint thin plastic bottles with paint (inside or outside).
 - Have students choose a color scheme for direction if you like.
 - Cut bottles with a spiral or strip technique.
 - The goal is for the students to experiment!
 - Have students punch a hole into one end to attach it to another piece or single piece of string.
 - As students are working, pose a few of the following questions to the students.
 - What color scheme did you choose and why?
 - What cutting techniques did you enjoy the best?
 - Does your sculpture look like anything?
 - Class discussions can involve ideas or opinions about their decisions, team work, Chihuly's influence, their creative contributions, etc.



Dale Chihuly, *Vivid Lime Icicle Tower*, 2022, Missouri Botanical Garden, St. Louis, installed 2023. © 2023 Chihuly Studio. All rights reserved. Photo by Nathaniel Willson.

- Plastic water bottles
- Scissors
- Hole punch
- String

Post-Visit Activity

- Chihuly's ceilings consist of hundreds, sometimes thousands, of individual glass pieces resting on ceiling or suspended overhead. The *Fiori di Como* at the Bellagio Resort in Las Vegas has over 2,000 hand blown glass pieces. The installation weighs some 40,000 pounds and is suspended across the seventy-by-twenty-foot ceiling. Lights from above project through the art glass and throw shadows and colored light onto the floor, walls, and observer. The *Seaform Pavilion* in Tacoma, WA is made of 2,364 objects from Chihuly's *Seaform* and *Persian* series. Placed on top of a fifty-by-twenty-foot plate-glass ceiling, the forms are suspended in midair and make dramatic use of natural light.
- Although on a smaller scale and using different materials your students could be able to experience the design, creativity and artistry involved in one of Dale Chihuly's ceilings.
 - The basic project involves creating a "stained glass" effect of overlapping tissue paper shapes glued onto a transparent surface. Light shining through the "ceiling" will resemble the effect of a Chihuly ceiling.
 - Allow students to research, study, discuss and make some decisions about Dale Chihuly's choice of forms that he uses in his ceilings. Stress how many of his forms relate to sea or organic forms.
 - Discussions should involve ideas about color choices, transparency, composition, etc.
 - Make preliminary drawings of the shapes they might use in their "ceiling". Transfer their designs directly to the tissue paper, or better yet, transfer the designs to a heavier paper in which the tissue paper will be sandwiched.
 - Tissue paper is easier to cut with scissors if it is placed between two layers of a stiffer paper. Make sure they consider the size of their piece of glass and of their shapes so they are not too big.
 - When the students have enough shapes to work with, let them play around with the composition on the glass.



Fiori di Como, 1998 Bellagio Resort, Las Vegas

- Old picture frames (or new) with the glass, or Plexiglas, or actual windows.
- Tissue paper or similar translucent paper in a variety of colors.
- Scissors to cut the paper.
- White glue (watered down 50/50 with water) or acrylic medium.
- Hanging materials to hang the frames either flat from the ceiling or vertically over a window.
- Don't rush the gluing process; at this stage composition is most important.
- When a great composition is achieved begin gluing the pieces of tissue paper down layer by layer.
- White glue watered down 50% with water will work or you can use acrylic medium.
- Let dry.
- Place the glass back into the frame and secure. Using screw eyes on the back either hang the frame in front of a bright window or hang it horizontally under a ceiling light.
- Follow up with a discussion about designing, transparency, the affect, creativity, aesthetics, etc.

RESOURCES

Glass and Art Websites

<u>www.Chihuly.com</u> — All you want to know about Dale Chihuly and his artwork with images of his installations, individual pieces, drawings, and team work in the studio

www.stlglass.com — Third Degree Glass Factory has a 45 second clip showing demonstration of glass making

www.laumeier.com – An outdoor sculpture museum

www.exploratorium.edu/cooking/candy/kitchenlab.html — A website on the science of making candy, they have information on fudge and rock candy's microcrystal structure that closely resembles that of glass

Literature Resources

Ahmed & Cheung | *Alma's Art*, 2002 Chihuly, Cobb & Linn | *Kids Design Glass*, 2009 Geeslin | *Elena's Serenade*, 2004 Greenburg & Jordan | *World of Glass: The Art of Dale Chihuly*, 2020 Reynolds | *The Dot*, 2003



Dale Chihuly, *Summer Sun*, 2010. Missouri Botanical Garden, St. Louis, installed 2023. © 2023 Chihuly Studio. All rights reserved. Photo by Nathaniel Willson.



CHIHULY IN THE GARDEN 2023

- A. South Entry Gardens / *Vivid Lime Icicle Tower*
- B. Emerson Conservatory / Chromatic Neon
- C. Emerson Conservatory / River and Cobalt Fiori
- D. Heckman Rock Garden / Black and Green Striped Herons with Green Grass
- E. Climatron / Red Bulbous Reeds
- F. Climatron / Ikebana
- G. Climatron / Macchia Forest
- H. Climatron / Ethereal Spring Persians
- I. Kemper Center for Home Gardening / Vermilion and **Canary Yellow Tower**
- J. Chinese Garden / Turquoise Marlins and Floats
- K. Blanke Boxwood Gardenn / White Tower
- L. Japanese Garden / Float Boat and Niijima Floats
- M. Japanese Garden / Red Reeds
- N. English Woodland Garden / Fiddlehead Ferns
- O. Lehmann Rose Garden / Neodymium Reeds on Logs P. Sachs Museum South Gallery / Individual Works & Drawings
- Q. Jenkins Daylily Garden / Summer Sun
- R. Central Axis / Fiori Boat and Fiori di Primavera
- S. Swift Family Garden Walkway / Cattails and Copper Birch Reeds
- T. Linnean House / Burnished Amber, Citron, and Teal Chandeliers
- 1. Jack C. Taylor Visitor Center

- 4. Bakewell Ottoman Garden
- 5. Zimmerman Sensory Garden
- 7-8. Heckman and Samuels
- 9. Spink Pavilion
- 10. Goodman Iris Garden
- 11. Dry Streambed Garden
- 12. Jenkins Daylily Garden
- 13. Herring House (Not Open to Public)
- 14. Stephen and Peter Sachs Museum Tuesdays-Sundays | 11:30 a.m.-4 p.m.
- 16. Tower Grove House
- Wednesdays-Sundays | 10 a.m.-4 p.m. 17. Herb Garden
- 18. Kresko Victorian Garden
- 19. Pincushion Garden
- 20. Piper Observatory and Kaeser Maze

- 21. Stumpery
- 22. Pfautch Bavarian Garden
- 23. Strassenfest German Garden
- 24. Cherbonnier English Woodland Garden
- 25. Japanese Garden
- 26. Koi Fish Feeding Bridge
- 27. Carver Garden
- 28. Blanke Boxwood Garden
- 29. William T. Kemper Center for Home Gardening
- 30. Cohen Amphitheater
- 31. Grigg Nanjing Friendship Chinese Garden
- 32. Lehmann Rose Garden
- 33. Doris I. Schnuck Children's Garden Tuesdays-Sundays | 9 a.m.-4 p.m.
- 34. Brookings Exploration Center and Plantlab
- 35. Climatron
- 36. Shoenberg Temperate House (Closed)
- 37. Heckman Rock Garden

DRIVING DIRECTIONS FOR SCHOOL GROUPS

Teachers, please provide a copy of this document to all Bus Drivers. The Missouri Botanical Garden is located on the corner of Shaw Boulevard and Tower Grove Avenue.



From Downtown via I-44: Follow Memorial Drive south to I-44 west. Exit at Vandeventer/Kingshighway (Exit #287 B-A) and turn left on Vandeventer, then left on Shaw Boulevard. The Garden will be on your right.

From North via I-70: Take I-70 east into downtown St. Louis. Merge onto I-55 south to I-44 west. Exit at Vandeventer/ Kingshighway (Exit #287 B-A) and turn left on Vandeventer. Then turn left on Shaw Boulevard. The Gar-den will be on your right.

From West via I-64/40: Take I-64 east. Take the Kingshighway North & South exit (Exit #36 A-B) and turn right. Turn left at the stoplight for Southwest/Vandeventer. Turn right onto Shaw Boulevard. The Garden will be on your right.

From Southwest via I-44: T ake I-44 east. Exit at Vandeventer (Exit #287 B) and turn right. Then turn left on Shaw Boulevard. The Garden will be on your right.

From East via I-44: Take I-70 west across the Poplar Street Bridge. Merge onto I-55 south to I-44 west. Exit at Vandeventer/Kingshighway (Exit #287 B-A) and turn left. Then turn left on Shaw Boulevard. The Garden will be on your right.

From Lambert-St. Louis Intl. Airport via I-170: Take I-70 east toward St. Louis. Merge onto I-170 south (Exit #238 B). Merge onto I-64 east (Exit #1 A). Take the Kingshighway North & South exit (Exit #36 A-B) and turn right. Turn left at the stoplight for Southwest/Vandeventer. Turn right onto Shaw Boulevard. The Garden will be on your right.

From South via I-55:Take I-55 north to I-44 west. Exit at Vandeventer/Kingshighway (Exit #287 B-A) and turn left. Then turn left on Shaw Boulevard. The Garden will be on your right.

For more specific directions, interactive maps can be accessed through our website at: www.missouribotanicalgarden.org/visit/the-garden/getting-here.aspx

DROP-OFF/BUS PARKING

Thank you for planning your group visit to the Missouri Botanical Garden.

Please follow the bus parking procedures detailed below. If you have an emergency, please contact security at (314) 577-0212.

4344 Shaw Boulevard St. Louis, MO 63110 (314) 577-5100 • mobot.org

The Missouri Botanical Garden is a tobacco-free environment.



Main Entrance

Drop-off/Parking

- 1 Enter via the main Garden entrance from Shaw Blvd. At the top of the drive, turn left, heading east.
- Proceed to the end of the drive, then turn right and stop at the end of the drive.
- 3 Passengers may exit the bus and proceed to the entrance at the Linnean Plaza gate.
- Once passengers have unloaded, proceed straight, an exit through the gate onto Tower Grove Ave. The gate will automatically open.
- S To reach onsite bus parking, re-enter the main parking lot on Shaw Blvd. and turn right. Proceed to the end of the drive and follow the circle drive to the designated bus parking spots. If these spots are not available, proceed to the Garden's offsite bus parking.
- To reach the Garden's offsite overflow bus parking lot, from the Tower Grove Ave. gate exit, turn left, then turn left at the traffic light onto Shaw Blvd.

Passenger Reboarding/Exiting

Passengers will reboard the bus in the same location where they were dropped off. Once loaded, please exit the Garden to the left through the Tower Grove Ave. gate (located on the east side of the Bayer Event Center).

Please note: Garden security may redirect coaches to alternative parking.



The Garden's multi-modal lots (for bus parking) are located at the corner of Shaw Blvd. and Vandeventer Ave.

Bus drivers are invited to enjoy free admission to the Missouri Botanical Garden.

GLOSSARY

from The Corning Museum of Glass - www.cmog.org, unless otherwise noted.

Annealing - The process of slowly cooling a completed object in an auxiliary part of the glass furnace, or in a separate furnace. This is an integral part of glassmaking because if a hot glass object is allowed to cool too quickly, it will be highly strained by the time it reaches room temperature; indeed, it may break as it cools. Highly strained glasses break easily if subjected to mechanical or thermal shock.

Art Glass - (1) Several types of glass with newly developed surface textures, shaded colors, or casing, made in the United States from about 1870 and in Europe between about 1880 and 1900; (2) more generally, any ornamental glassware made since the mid-19th century.

Bar - A single piece of glass formed by fusing several canes or rods. A bar can be cut into numerous slices, all with the same design, to be used as inlays or appliqués, or in making mosaic glass.

Batch - The mixture of raw materials (often silica, soda or potash, and lime) that is melted in a pot or tank to make glass. Cullet is added to help the melting process.

Battledore - A glassworker's tool in the form of a square wooden paddle with a handle. Battledores are used to smooth the bottoms of vessels and other objects.

Blank - Any cooled glass object that requires further forming or decoration to be finished.

Blobbing - The technique of decorating hot glass by dropping onto the surface blobs of molten glass, usually of a different color or colors.

Blowpipe - An iron or steel tube, usually about five feet long, for blowing glass. Blowpipes have a mouthpiece at one end and are usually fitted at the other end with a metal ring that helps to retain a gather.

Borsella - A tong like tool used for shaping glass. The borsella puntata has a pattern on the jaws, which was impressed on the glass.

Casing - The application of a layer of glass over a layer of contrasting color. The gaffer either gathers one layer over another gather, or inflates a gob of hot glass inside a preformed blank of another color. The two components adhere and are inflated together (perhaps with frequent reheating) until they have the desired form. Sometimes, the upper layer is carved, cut, or acid etched to produce cameo glass.

Casting - The generic name for a wide variety of techniques used to form glass in a mold.

Clamp - A tool sometimes used instead of a pontil to hold the closed end (usually the bottom) of a partly formed glass vessel while the open end (usually the mouth) is being shaped. See also Gadget.

Clapper - A tool consisting of two rectangular pieces of wood joined at one end by a leather hinge. There is an aperture in one of the pieces of wood, and this holds the stem of a goblet or wineglass while it is being made. The clapper is used to squeeze a blob of glass in order to form the foot.

Core Forming - The technique of forming a vessel by trailing or gathering molten glass around a core supported by a rod. After forming, the object is removed from the rod and annealed. After annealing, the core is removed by scraping.

Cracking off - The process of detaching a glass object from a blowpipe or pontil.

Cullet - (1) Raw glass or pieces of broken glass from a cooled melt; (2) scrap glass intended for recycling.

Cutting - The technique whereby glass is removed from the surface of an object by grinding it with a rotating wheel made of stone, wood, or metal, and an abrasive suspended in liquid. See also copper-wheel engraving, carving, and wheel engraving

Flux - A substance that facilitates fusion (by lowering the melting temperature of another substance). For example, a flux is added to the batch in order to facilitate the fusing of the silica. Fluxes are also added to enamels in order to lower their fusion point to below that of the glass body to which they are to be applied. Potash and soda are fluxes.

Founding - The initial phase of melting batch. For many modern glasses, the materials must be heated to a temperature of about 2450° F (1400° C). This is followed by a maturing period, during which the molten glass cools to a working temperature of about 2000° F (1100° C).

Furnace - An enclosed structure for the production and application of heat. In glassmaking, furnaces are used for melting the batch, maintaining pots of glass in a molten state, and reheating partly formed objects at the glory hole.

Fusing - (1) The process of founding or melting the batch; (2) heating pieces of glass in a kiln or furnace until they bond (see casting and kiln forming); (3) heating enameled glasses until the enamel bonds with the surface of the object.

Gaffer - (English, corruption of "grandfather") The master craftsman in charge of a chair, or team, of hot-glass workers.

Gather - (Noun) A mass of molten glass (sometimes called a gob) collected on the end of a blowpipe, pontil, or gathering iron; (verb) to collect molted glass on the end of a tool.

Gathering iron - A long, thin rod used to gather molted glass.

Glass - A homogeneous material with a random, liquid like (non-crystalline) molecular structure. The manufacturing process requires that the raw materials be heated to a temperature sufficient to produce a completely fused melt, which, when cooled rapidly, becomes rigid without crystallizing.

Glassblowing - The technique of forming an object by inflating a gob of molten glass gathered on the end of a blowpipe. The gaffer blows through the tube, slightly inflating the gob, which is then manipulated into the required form by swinging it, rolling it on a marver, or shaping it with tools or in a mold; it is then inflated to the desired size.

Glory hole - A hole in the side of a glass furnace, used to reheat glass that is being fashioned or decorated. The glory hole is also used to fire-polish cast glass to remove imperfections remaining from the mold.

Jimmies - Small bits of colored glass added to the exterior of the glass object while it is being blown.

Lehr, leer - The oven used for annealing glassware. Early lehrs were connected to the furnace by flues, but the difficulty of controlling heat and smoke made this arrangement impracticable. Later lehrs were long, bricklined, separately heated tunnels through which the glass objects were slowly pushed; the glass remained in the lehr for several hours, while it was gradually reheated and then uniformly cooled. Today, lehrs work on a conveyor belt system.

Lime - Calcined limestone, which, added to the glass batch in small quantities, gives stability. Before the 17th century, when its beneficial effects became known, lime was introduced fortuitously as an impurity in the raw materials. Insufficient lime can cause crizzling.

Lip wrap - the defining line of color that is applied to the edge of some of Chihuly's series

Marver - (French marbre, "marble") A smooth, flat surface, on which softened glass is rolled when attached to the blowpipe or pontil in order to smooth it or to consolidate applied decoration.

Melt - The fluid glass produced by melting a batch of raw materials.

Metallic oxide - The oxide of a metal, this may be used as a pigment to color glass and enamels (see enamels), or to produce luster or iridized surfaces. The resultant color depends on the nature of the glass itself, the purity of its ingredients, and the furnace conditions. (i.e., the degree of heat and the presence or absence of oxygen). (www. glasstopia.com)

Mold - A form, normally made of wood or metal, used for shaping and/or decorating molten glass. Some molds (e.g., dip molds) impart a pattern to the parison, which is then withdrawn, and blown and tooled to the desired shape and size; other molds are used to give the object its final form, with or without decoration.

Parison - (French, paraison) A gather, on the end of a blowpipe, which is already partly inflated.

Pontil rod - The pontil, or punty, is a solid metal rod that is usually tipped with a wad of hot glass, and then applied to the base of a vessel to hold it during manufacture. It often leaves an irregular or ring-shaped scar on the base when removed. This is called the "pontil mark."

Pot - A fire clay container placed in the furnace in which the batch of glass ingredients is fused, and kept molten. The glassworker gathers directly from the pot. **Potash** - Potassium carbonate. It is an alternative to soda as a source of alkali in the manufacture of glass. Potash glass is slightly denser than soda glass; it passes from the molten to the rigid state more quickly, and it is therefore more difficult to manipulate into elaborate forms. However, it is harder and more brilliant, and lends itself to decorative techniques such as facet cutting and copper-wheel engraving.

Prunt - A blob of glass applied to a glass object as decoration, but also to afford a firm grip in the absence of a handle.

Rod - A monochrome segment of glass cut from a trail.

Sand - The most common form of silica used in making glass. It is collected from the seashore or, preferably, from deposits that have fewer impurities. For most presentday glassmaking, sand must have a low iron content. Before being used in a batch, it is thoroughly washed, heated to remove carbonaceous matter, and screened to obtain uniformly small grains.

Shears - A tool used to trim excess hot glass from an object in the course of production.

Silica - Silicon dioxide, a mixture that is the main ingredient of glass. The most common form of silica used in glassmaking has always been sand.

Soda - Sodium carbonate. Soda (or alternatively potash) is commonly used as the alkali ingredient of glass. It serves as a flux to reduce the fusion point of the silica when the batch is melted.

Thermal shock - Glass breakage caused by rapid or uneven heating or cooling (www.collectorsguide.com)

Trail - A strand of glass, roughly circular in section, drawn out from a gather

Viscosity - The quality or state of being viscous; the physical property of a liquid or semi liquid that enables it to develop and maintain a certain amount of shearing stress dependent upon the velocity of flow and then to offer continued resistance to flow.

Working point - Viscosity at which glass is suitable for working or forming.



Dale Chihuly, *Cattails and Copper Birch Reeds* (detail), 2020. Cheekwood Estate & Gardens, Nashville. © 2023 Chihuly Studio. All rights reserved. Photo by Scott Mitchell Leen.

CHIHULY IN THE GARDEN 2023

Hours: Daily, 9 a.m.-5 p.m.

Admission: Included with Garden admission. \$14 ages 13 and up. \$6 St. Louis Residents (proof of residency required). \$14 seniors 65+. FREE for members.

