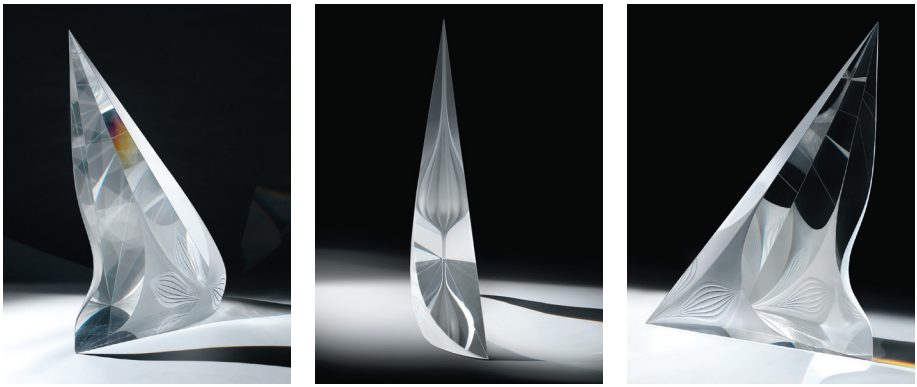
# The Properties of Colorless Glass

The near-perfect transparency and reflectivity of the sculpture *Holiday* by American artist Christopher Ries could be seen as a culmination of the historical quest for colorless glass. This artwork exemplifies many of the unique optical properties of transparent colorless glass: how it reflects, refracts, and transmits light.



**Christopher Ries** (American, born 1952), ***Holiday***, 1998, Cut, ground, and polished optic crystal, Gift of Stanley Asrael, 2019.47.2

Early in his career, Ries set out to find a perfectly clear and colorless glass. He discovered the optical-quality glass ("optic crystal") produced by Schott North America of Duryea, Pennsylvania, which is highly refined and free from impurities.

Ries carved *Holiday* from a solid block of glass as if it were marble or wood. The surface has just one small area of matte decorative cutting, which is reflected and refracted throughout the sculpture, allowing Ries to essentially sculpt with light. The polished sides of the glass act like facing mirrors and create additional internal forms by means of "hinge reflections" that bounce light back and forth endlessly. The result is a simple sculptural form that is deeply complex in its expression.

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**THE OPTICAL PROPERTIES OF GLASS** relate to how visible light interacts with the material's atomic structure and whether the light photons (the smallest particles of light) are absorbed, reflected, or transmitted.

**COLOR** connects directly to the absorption of light. Within the spectrum of visible light, each wavelength represents a particular color that we see. Colored glass transmits the color that the glass appears to be and absorbs the other colors. Colorless glass transmits all colors of the visible light spectrum.

**TRANSPARENCY** is the ability of light to pass through a material with little absorption or scattering. Glass transmits much of the light that strikes it, thus appearing transparent to our eyes. Regular window glass absorbs about 30% of the light photons that travel through it. Absorption also reduces the intensity of light. The optical glass used by Christopher Ries for *Holiday* transmits nearly all light, absorbing only .02-.04% of photons.

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**TRANSLUCENCY** is the ability of light to pass through a material in a diffuse manner. Transparent glass can be made translucent by manipulating the surface to create microscopic irregularities, which cause light photons to reflect in many different directions. Acid etching, sandblasting, engraving, cutting, and kiln casting are all methods that can roughen the surface to reduce transparency and make colorless glass look matte or frosted in appearance.

**REFLECTION AND REFRACTION** pertain to how light travels in a straight line until it hits something. When light hits the surface of glass, some photons change direction (reflect), but most of the light transmits. When light passes into a dense material like glass, it slows down and bends (refracts). Adding a dense ingredient like lead to glass causes light to travel even slower through the material, giving it a higher index of refraction (degree of light bending) and making the glass appear more brilliant.

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1 Designer, **Thomas Cains** (English, 1779–1865), **Manufacturer, possibly South Boston Flint Glass Works** (American, 1813–27), ***Compote***, ca. 1810–20, Blown glass, Gift of Dr. and Mrs. James Etheridge in honor of Mary Stuart Gooch Etheridge, 2017.20

2 **Gillinder & Sons** (American, 1867–1930), ***Ruth the Gleaner***, **1876**, After Randolph Rogers, American, 1825–92, Pressed and acid-etched glass, Gift of Crawford Alexander Mann III, 2018.10

3 **Stanislav Libenský** (Czech, 1921–2002) and **Jaroslava Brychtová** (Czech, 1924–2020), ***Cubus***, 1967, Cast glass in five parts, cut and polished, Museum purchase, 94.7