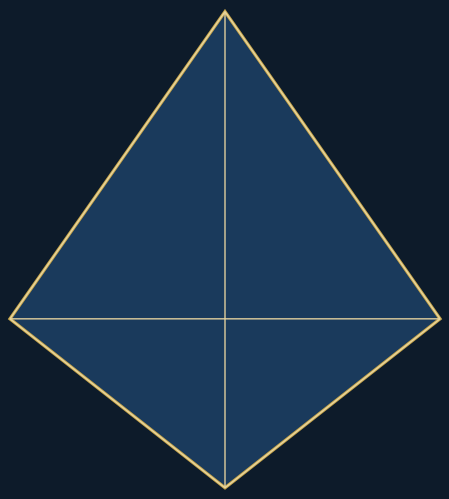


GEMSTONES

by Color & Hardness

A Visual Reference Guide · Identification · Mohs Scale · Crystal Systems

Table of Contents

Introduction

Gemstones have captivated humanity for thousands of years — worn as symbols of power, traded across continents, and embedded in the myths of every civilization. What makes a stone a gemstone? Three qualities: **beauty**, **rarity**, and **durability**. Beauty draws the eye; rarity makes a stone desirable; durability ensures it survives the passage of time.

This ebook is organized first by **color** — the quality most people notice first — and then by special topic: gem families (garnet, beryl, tourmaline), pearl colors, the Mohs hardness scale, standard cut shapes, and crystal symmetry systems. Whether you are trying to identify an unknown stone, choose a gem for a piece of jewelry, or simply expand your knowledge of mineralogy, this guide offers a visual and descriptive foundation.

Why color? Color is caused by the selective absorption of light wavelengths by trace elements or structural defects within a mineral. Iron produces blues, greens, and yellows depending on its oxidation state. Chromium creates vivid reds and greens. Manganese gives pinks and oranges. The same mineral can appear in completely different colors — sapphire, for instance, occurs in every color of the rainbow, even black, simply by varying trace element concentrations.

A note on hardness: The Mohs scale (Chapter 18) rates scratch-resistance from 1 (talc) to 10 (diamond). Gems rated 7 or above are generally considered durable enough for rings and bracelets. Softer stones are better suited to pendants and earrings that receive less abrasive wear. Throughout this guide, Mohs ratings are noted to help you make informed choices about gemstone use and care.

CHAPTER 1

Brown Gemstones

Brown is one of nature's most versatile gem colors — earthy, warm, and often overlooked in favor of flashier hues, yet home to some of the most optically remarkable stones in the mineral kingdom.

Overview

Brown gemstones owe their warm tones to iron, manganese, and titanium impurities within their crystal lattices. They span a remarkable spectrum: from the pale champagne of smoky quartz to the deep chocolate of hessonite garnet, from the fire-flecked play of opal to the silky shimmer of tiger eye. Once dismissed as secondary stones, brown gems have enjoyed a significant renaissance in contemporary jewelry design, prized for their organic warmth and earthy sophistication.

Popular Brown Gemstones

Tiger Eye (Mohs 7)

One of the most distinctive gems in existence, tiger eye is a variety of quartz that has replaced crocidolite fibers, producing the famous golden-brown chatoyancy (cat's eye effect). The silky, rippling band of light that moves across the stone's surface — called a 'silk' — makes it immediately recognizable. Affordable and durable, it is popular in beads, cabochons, and men's jewelry.

Smoky Quartz (Mohs 7)

The smoky brown-to-black variety of quartz, colored by natural irradiation of aluminum-bearing quartz. It ranges from pale tan to deep black ('morion'). Large, clean crystals are common, making fine faceted stones available at modest prices. Scotland's Cairngorm Mountains produce a celebrated variety called Cairngorm stone.

Hessonite Garnet (Mohs 6.5–7.5)

A cinnamon-orange variety of grossular garnet, hessonite has been treasured since antiquity. Known in Ayurvedic tradition as 'gomed,' it is believed to represent the planet Rahu. Its warm, syrupy color — sometimes called 'cinnamon stone' — is caused by iron and manganese.

Andalusite (Mohs 7.5)

A strongly pleochroic stone — it shows different colors (brown, green, red) from different viewing angles — andalusite is a mineralogical curiosity that has grown in collector popularity. Well-cut stones flash green and brownish-red alternately. The chiastolite variety displays a natural cross-shaped inclusion pattern.

Axinite (Mohs 6.5–7)

Characterized by its unusual axe-blade crystal habit and strong pleochroism from clove-brown to violet-brown to olive-yellow, axinite is a collector's gem rarely seen in mainstream jewelry. Fine specimens

come from France, Mexico, and Tanzania.

Chrysoberyl Cat's Eye (Mohs 8.5)

The finest cat's eye gemstone in the world — so quintessential that gemologists simply say 'cat's eye' without a mineral qualifier, implying chrysoberyl. The silky band of light (chatoyancy) results from parallel needle-like inclusions of rutile. Fine stones from Sri Lanka display a 'milk and honey' effect where one side of the eye appears milky white and the other honey gold.

Brookite (Mohs 5.5–6)

A titanium oxide mineral, brookite is among the rarest facetable gems. Its brown-to-reddish-brown crystals are collected more for their striking blade-shaped habit than for use in jewelry. Fine faceted brookite is a serious collector's prize.

Care & Durability

- Most brown gems (quartz, garnet, chrysoberyl) rate 6.5–8.5 on the Mohs scale — suitable for most jewelry.
- Tiger eye and agate are best cleaned with mild soap and water; avoid ultrasonic cleaners.
- Hessonite garnet may be sensitive to sudden temperature changes; avoid steam cleaning.
- Chrysoberyl cat's eye is one of the hardest gems and requires minimal special care.

Brown Gemstones


LIST OF BROWN GEMSTONES
LabradoriteKING.com
Opal
Smoky Quartz
Enstatite
Diamond
Brookite
Andalusite
Axinite
Hessonite Garnet
Tourmaline
Chrysoberyl cats eye
Tiger Eye
Jasper
Rutile
Agate
Sapphire
Apatite Cat's Eye
Cassiteriteye
Alexandrite
Beryl
Disapore
Moonstone
Sphalerite
Zoisite
Topaz
Sphene
Amber
Labradorite
Honey quartz
Moissanite
Spinel

CHAPTER 2

Purple & Violet Gemstones

Purple and violet gemstones carry an aura of mystery and royalty. From the commonplace amethyst to the almost impossibly rare benitoite, this color family spans the full range of gem rarity.

Overview

Violet and purple hues in gemstones arise from several different causes. In amethyst, iron impurities within quartz are irradiated by natural gamma rays in the host rock, producing the characteristic purple color. In tanzanite, vanadium and the interaction of heat with a trichroic crystal produce the coveted blue-violet. Manganese drives the lavender of kunzite and the purple of rhodolite garnet. Historically, purple dye was extraordinarily expensive (derived from sea snails), so purple gems were associated with wealth and imperial power. Roman emperors wore amethysts; the British Crown Jewels contain spectacular purple sapphires.

Popular Purple & Violet Gemstones

Amethyst (Mohs 7)

The most popular and commercially significant purple gem. A variety of quartz colored by iron and natural irradiation, amethyst ranges from pale lilac to deep royal purple. The finest stones — 'Deep Russian' amethyst — display a rich, saturated purple with red flashes. Brazil and Zambia are the leading sources; Zambian stones tend toward deeper, cooler purple while Brazilian stones lean toward lighter, warmer tones. Amethyst was considered as precious as ruby or sapphire until large deposits were discovered in Brazil in the 19th century.

Tanzanite (Mohs 6.5)

Discovered only in 1967 in Tanzania — the only place it exists on Earth — tanzanite is one of the rarest gem minerals. Its extraordinary trichroism (three different colors from three axes: blue, violet, burgundy) and velvety blue-violet color rapidly made it among the world's most desired gems. Tiffany & Co. named and popularized it. Because it forms from a unique combination of geology that will never be replicated elsewhere, tanzanite is considered a 'once in a lifetime' gem.

Iolite (Mohs 7–7.5)

Also called 'water sapphire,' iolite displays striking dichroism — appearing blue-violet in one direction and nearly colorless or pale yellow in another. Vikings reportedly used thin slices of iolite as a polarizing lens to navigate by the sun on overcast days. Affordable and attractive, it is an underappreciated gem.

Lavender Jade (Mohs 6.5–7)

The rarest and most expensive variety of jadeite jade. Its pale lavender-purple color results from manganese and iron. Lavender jadeite from Myanmar commands premium prices in Asian markets.

Sugilite (Mohs 6–6.5)

A relatively modern gem mineral (discovered 1944, gem-quality material found in 1975 in South Africa), sugilite produces a uniquely vivid pink-to-purple color with no natural rival in the gem world. It is used primarily in cabochons and beads. Fine material is called 'gel sugilite' and is highly sought by collectors.

Benitoite (Mohs 6–6.5)

The official state gem of California and one of the rarest gems on Earth, found only in a single mine in San Benito County. Its blue-violet color rivals fine sapphire, and its dispersion (fire) exceeds that of diamond. Only small crystals exist — stones over one carat are extremely rare.

Purple Sapphire (Mohs 9)

Corundum containing a mix of chromium and iron produces purple sapphire. Much rarer than blue sapphire, fine purple sapphires are valued collector gems. Their exceptional hardness (9 on Mohs) makes them ideal for any jewelry use.

Care & Durability

- Amethyst (Mohs 7) is suitable for most jewelry but should be protected from prolonged sunlight, which can fade color.
- Tanzanite (Mohs 6.5) is relatively fragile and should not be worn in rings for everyday use; earrings and pendants are safer.
- Sugilite is soft (6–6.5) and porous; avoid ultrasonic cleaners and harsh chemicals.
- Purple sapphire is extremely durable (Mohs 9) and requires no special care beyond routine cleaning.

Purple & Violet Gemstones


dumortierite
fluorite
garnet
liolite
pearl
pollucite
jade
kornerupine
kunzite
quartz
rhodolite
sapphire
labradorite
lapis lazuli
lepidolite
scapolite
sillimanite
sodalite
spinel
sugalite
taaffeite
agate
alexandrite
almandine
tanzanite
topaz
tourmaline
amethyst
ametrine
benitoite
umbalite
vesuvianite
zoisite
chalcedony
charoite
diamond

CHAPTER 3

Red Gemstones

Red is the rarest and most coveted color in the gem world. The finest rubies command higher per-carat prices than any other gemstone — including diamonds.

Overview

Red in gemstones is primarily caused by chromium, which absorbs green and blue light and re-emits red wavelengths — sometimes with a fluorescent glow under ultraviolet light that makes fine rubies appear to 'burn' with inner fire. Iron produces the darker, cooler reds seen in almandine garnet. Manganese gives the pinkish-reds of rhodochrosite. The deeper the chromium content and the fewer the masking iron impurities, the more vivid — and expensive — the red.

Popular Red Gemstones

Ruby (Mohs 9)

The 'king of gemstones,' ruby is red corundum (aluminum oxide) colored by chromium. The most prized color is 'pigeon blood' — a pure, vivid red with a hint of blue, found in Myanmar's Mogok Valley. Burma (Myanmar) rubies have commanded over $1 million per carat at auction. Ruby's hardness (9), brilliance, and rarity combine to make it the world's most valuable gem by weight. Fine rubies above 3 carats are rarer than equivalent-quality diamonds.

Red Garnet — Pyrope & Almandine (Mohs 7–7.5)

Pyrope garnet ('fire-like') displays a pure, vivid red with hints of orange, colored by chromium and iron. Almandine is darker, with a brownish-red tone from iron. Together, these are the most common red garnets, affordable and durable. 'Bohemian garnets' — small, deep-red pyropes set in clusters — were fashionable in Victorian jewelry.

Red Spinel (Mohs 8)

For centuries, the finest red spinels were mistaken for rubies — including the 170-carat 'Black Prince's Ruby' in the British Crown Jewels, which is actually a spinel. Spinel is colored by chromium and sometimes displays even more vivid reds than ruby, with fewer inclusions. It has gained enormous popularity as gem collectors increasingly prefer natural, untreated stones (spinel is rarely heated).

Rhodochrosite (Mohs 3.5–4)

A manganese carbonate mineral with a distinctive raspberry-to-rose red color, often with beautiful white banding. Argentina's Inca Rose mine produces gem-quality material; stalactitic rhodochrosite is cut into stunning banded cabochons. Its softness limits jewelry use, but it is spectacular in pendants and display pieces.

Rubellite Tourmaline (Mohs 7–7.5)

The vivid pink-to-red variety of tourmaline, rubellite owes its color to manganese. It is distinguished from other pink tourmalines by retaining its red under incandescent light (rather than shifting to pink). Fine rubellite from Paraíba, Nigeria, and Mozambique rivals ruby in intensity.

Red Beryl (Bixbite) (Mohs 7.5–8)

One of the rarest gems in existence — found commercially only in Utah's Wah Wah Mountains. Its vivid raspberry-red color is caused by manganese. Gem-quality crystals are tiny; stones over 0.5 carats are exceptional. Red beryl is estimated to be 1,000 times rarer than gem-quality diamond.

Care & Durability

- Ruby and red spinel (Mohs 8–9) are highly durable — excellent for rings and daily wear.
- Most red garnets (Mohs 7–7.5) are suitable for rings but should be protected from hard knocks.
- Rhodochrosite (Mohs 3.5–4) is too soft and fragile for rings; best in protected settings as pendants.
- Rubellite tourmaline should be cleaned with warm soapy water; avoid ultrasonic cleaners if inclusions are present.

Red Gemstones


opal
rhodochrosite
rhodonite
cuprite
diamond
dumortierite
ruby
serpentine
sphalerite
fluorite
garnet
jade
spinel
sunstone
taaffeite
jasper
kyanite
onyx
cuprite
diamond
dumortierite
agate
amber
apatite
fluorite
garnet
jade
beryl
celestine
chalcedony
jasper
kyanite
onyx
chrysoberyl
copal
coral

CHAPTER 4

Green Gemstones

Green is one of the most color-diverse categories in gemology. From the saturated emerald of Cleopatra's treasury to the alien green of moldavite — a gem formed from a meteor impact — few color groups offer such variety.

Overview

Green color in gems comes from several chromophores: chromium and vanadium produce the vivid greens of emerald and tsavorite; iron gives the yellow-greens of peridot and demantoid; nickel colors chrysoprase; and copper colors dioptase. The breadth of green gems means there is a green stone for virtually every budget and aesthetic, from common aventurine and malachite to the world's rarest alexandrite and demantoid garnet.

Popular Green Gemstones

Emerald (Mohs 7.5–8)

The most famous green gem and one of the 'Big Four' precious stones alongside diamond, ruby, and sapphire. A green variety of beryl colored by chromium and vanadium, fine emerald is distinguished by its unique deep, slightly bluish green. Colombian emeralds from Muzo and Chivor are the world standard; Zambian emeralds are also highly regarded for their blue-green tone. Nearly all emeralds contain inclusions (called 'jardin,' meaning garden) — a completely eye-clean emerald is extraordinarily rare and commands a premium.

Tsavorite Garnet (Mohs 7–7.5)

Discovered in Kenya's Tsavo region in the 1960s by geologist Campbell Bridges, tsavorite is a chromium-and-vanadium colored grossular garnet. Its vivid green rivals fine emerald but it is rarer, typically cleaner, and requires no oil treatment. Large tsavorites (above 3 carats) are exceptionally scarce.

Peridot (Mohs 6.5–7)

One of the few gems that occurs in only one color — olive to lime green — caused by iron. Ancient Egyptians called it 'gem of the sun' and mined it on the island of Zabargad (Topazios) in the Red Sea. Peridot also arrives from space: it has been found in meteorites (pallasites) and even in comet dust. Fine peridot from Pakistan's Sapat Valley displays a uniquely vivid lime green.

Alexandrite (Mohs 8.5)

The remarkable color-change variety of chrysoberyl — green in daylight, red under incandescent light — alexandrite is perhaps the most scientifically fascinating gem. Its color-change results from the way chromium absorbs light at precisely the boundary between red and green. Discovered in Russia's Ural Mountains in 1830, it was named for Tsar Alexander II. Fine Russian alexandrite is among the world's most expensive gems.

Malachite (Mohs 3.5–4)

A copper carbonate hydroxide with striking green banding, malachite has been used ornamentally for over 4,000 years. Catherine the Great decorated entire rooms of the Hermitage in malachite. Not suitable for faceting due to its softness, it is cut into cabochons, carvings, and decorative objects.

Moldavite (Mohs 5.5)

Unique in the gem world: moldavite formed about 15 million years ago when a meteorite struck what is now southern Germany, fusing terrestrial rock into glass that was scattered across Central Europe. Its distinctive bottle-green color and wrinkled, etched surface make it instantly recognizable. It is a form of tektite and is found only in the Czech Republic, Germany, and Austria.

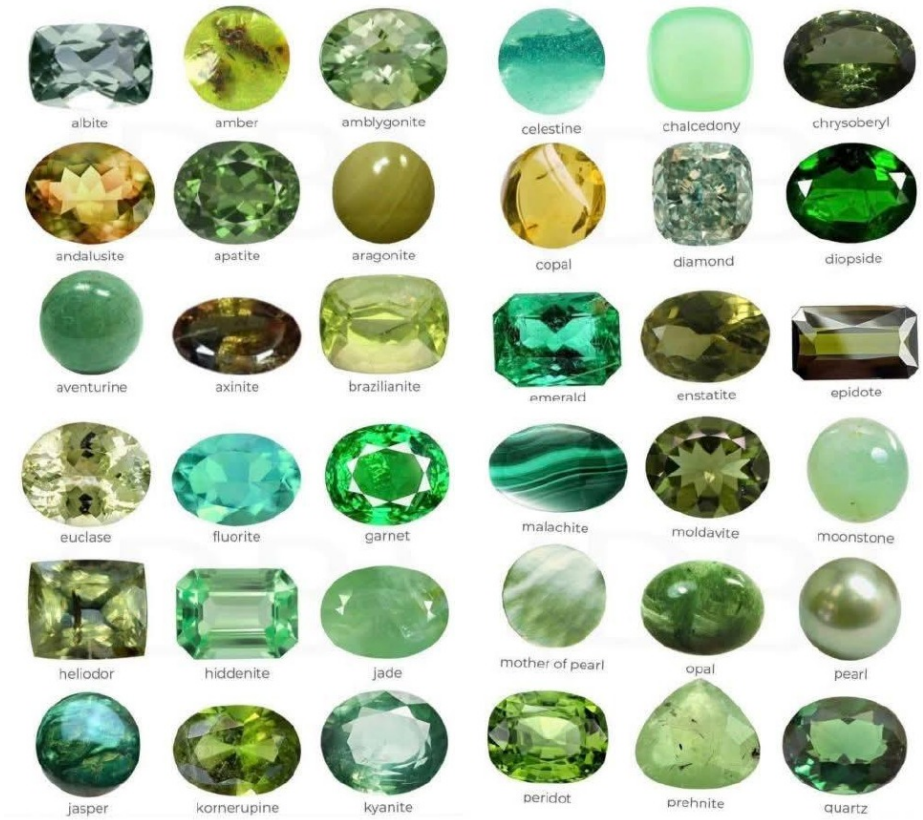
Hiddenite (Mohs 6.5–7)

The green variety of spodumene, hiddenite is colored by chromium. It was named after W. E. Hidden, who discovered it in North Carolina in 1879. Fine stones display a vivid, intense green. Large crystals are known but large faceted stones are rare.

Care & Durability

- Emerald is almost always oiled or resin-filled to improve clarity; clean only with mild soap and lukewarm water — never ultrasonic or steam.
- Peridot (Mohs 6.5–7) is somewhat brittle; avoid abrupt temperature changes and strong acids.
- Malachite (Mohs 3.5–4) is soft and reacts to acids, including perspiration. Clean gently with a dry cloth.
- Alexandrite and tsavorite (Mohs 7–8.5) are very durable and suitable for most jewelry applications.

Green Gemstones


albite
amber
amblygonite
celestine
chalcedony
chrysoberyl
andalusite
apatite
aragonite
copal
diamond
diopside
aventurine
axinite
brazilianite
emerald
enstatite
epidote
euclase
fluorite
garnet
malachite
moldavite
moonstone
heliodor
hiddenite
jade
mother of pearl
opal
pearl
jasper
kornerupine
kyanite
peridot
prehnite
quartz

CHAPTER 5

Blue Gemstones

Blue is the most universally beloved color in gemstones. From the royal cornflower blue of Kashmir sapphire to the electric neon of Paraíba tourmaline, the blue gem family is rich with desire and history.

Overview

Blue in gemstones is produced by several different causes. In sapphire, traces of iron and titanium interact to absorb red light and transmit blue. Lapis lazuli's blue comes from the mineral lazurite. Aquamarine and blue topaz are colored by iron. Paraíba tourmaline's neon blue-green results from copper — a chromophore so unusual in tourmaline that Paraíba stones are in a class of their own. Blue gems have consistently commanded premium prices throughout history because they combine rarity with the single most popular color in the world.

Popular Blue Gemstones

Blue Sapphire (Mohs 9)

The supreme blue gem, sapphire is blue corundum colored by iron and titanium. The finest color — 'cornflower blue' or 'royal blue' — is found in Kashmir (India), where sapphires with a velvety, luminous quality unique to that deposit have not been commercially mined since the 1930s, making them among the most valuable gems per carat. Sri Lanka (Ceylon) produces lighter, classic blues; Burma and Madagascar produce vivid royal blues.

Tanzanite (Mohs 6.5)

Although covered in Chapter 2, tanzanite's primary face-up color is a rich blue-violet that rivals the finest sapphire. Found only in a 4×2 km area near Arusha, Tanzania, it is considered by many geologists to be three times rarer than diamond in the ground.

Aquamarine (Mohs 7.5–8)

The serene sea-blue member of the beryl family, aquamarine is colored by ferrous iron. Its name means 'water of the sea' in Latin. The finest stones — from Brazil's Santa Maria de Itabira mine, called 'Santa Maria' aquamarines — display a deep, saturated blue. Large, clean crystals are common, making sizable faceted gems available.

Lapis Lazuli (Mohs 5–6)

Technically a rock rather than a mineral, lapis lazuli is a deep-blue metamorphic rock containing lazurite, calcite, and pyrite (which produces the characteristic gold flecks). Used as a pigment (ultramarine blue) and gem material since at least 6,000 BCE. The finest material — 'Afghan lapis' — has a deep, indigo-blue color with minimal calcite veining.

Blue Topaz (Mohs 8)

Natural blue topaz is pale; virtually all vivid blue topaz in the market has been irradiated and heated to develop 'Swiss Blue' (vivid medium blue) or 'London Blue' (deep inky blue) colors. Despite the treatment, blue topaz remains enormously popular due to its affordable price and excellent hardness.

Paraíba Tourmaline (Mohs 7–7.5)

Discovered in 1987 in Brazil's Paraíba state, Paraíba tourmaline caused a sensation because of its unparalleled neon blue-green color, caused by copper — a first for tourmaline. Fine stones appear to glow with an inner light. Prices exceed those of finest sapphire per carat. Similar copper tourmalines have since been found in Nigeria and Mozambique, but Brazilian material commands the highest premiums.

Blue Zircon (Mohs 7.5)

Not to be confused with cubic zirconia (a synthetic), blue zircon is a natural mineral with extraordinary fire and brilliance that exceeds diamond. Its vivid teal-to-sky blue color results from heat treatment. Cambodia is the primary source. Unfortunately, zircon's brittleness means facet edges can chip over time.

Care & Durability

- Sapphire (Mohs 9) is the most durable colored gemstone — safe for ultrasonic cleaning unless heavily included.
- Lapis lazuli (Mohs 5–6) is porous and reacts to acids; clean only with a damp cloth, no chemicals.
- Blue topaz (Mohs 8) is hard but has perfect cleavage — protect from sharp blows.
- Paraíba tourmaline should be cleaned with warm soapy water; avoid ultrasonic if inclusions are present.

Blue Gemstones


Blue Gemstone
Blue Sapphire
Blue Spinel
Blue Topaz
Lapis Lazuli
Lace Agate
Azurrite
LabradoriteKING.com
Chalcedony
Kyanite
Tanzanite
Labradorite
Zircon
Iolite
Opal
Turquoise
Larimar
Tourmaline
Apatite
Sodalite
Benitoite
Boleite
Blue Opal Lace
Moonstone
Veszelyite
Tiger Eye
Aquamarine
Fluorite
Scorodite
Kunzite
Moissanite
Garnet
Howlite
Diamond
Euclase
Jeremejevite
Linarite
Aventure

CHAPTER 6

Light Blue Gemstones

Light blue gemstones have an ethereal, calming quality — evoking clear skies and still water. Several of the most commercially popular gems in the world belong to this pale blue family.

Overview

The light blue category spans sky blue topaz, the pale icy blue of aquamarine, the spectral shimmer of moonstone, and the rare collector stone jeremejevite. What unites them is a softness of hue — these are not the dark velvety blues of sapphire or tanzanite, but stones with an airy, almost translucent quality that flatters virtually every skin tone. Many light blue gems have been historically confused with each other: the name 'topaz' was once applied to any yellow or pale blue gem.

Popular Light Blue Gemstones

Aquamarine (Mohs 7.5–8)

Aquamarine at its lightest is a pale ice blue that recalls arctic glaciers. These lighter shades are actually the most natural — the deeper 'Santa Maria' blues are the exception. Large, clean aquamarines make dramatic statement pieces and are traditionally associated with sailors and safe sea voyages.

Blue Topaz — Sky & Swiss Blue (Mohs 8)

Sky Blue topaz is the palest commercially produced blue topaz — a clean, light blue with good clarity. It is one of the world's most commercially sold gems. Excellent hardness and typically large sizes available make it practical and attractive for everyday jewelry.

Larimar (Mohs 4.5–5)

Found only in a single remote location in the Dominican Republic, larimar is a variety of pectolite with a unique blue-to-blue-green color patterned with white, resembling a tropical ocean viewed from above. It is deeply embedded in Dominican culture and identity. Larimar's softness limits its use to protected settings.

Moonstone (Mohs 6–6.5)

A variety of feldspar that displays a floating, billowing light called adularescence — a blue or white glow that appears to move just below the surface as the stone is rotated. The finest moonstones, from Sri Lanka, show a vivid blue sheen over a colorless body. Moonstone has been treasured in India for millennia and is associated with the moon and feminine energy.

Light Blue Spinel (Mohs 8)

Spinel occurs in a light periwinkle to powder blue colored by cobalt or iron. These pastel spinels, sometimes called 'lavender spinel,' are increasingly popular with gem collectors who appreciate their exceptional hardness and natural, untreated character.

Jeremejevite (Mohs 6.5–7.5)

One of the rarest gems in existence, jeremejevite was first described in Siberia in 1883 and fine pale blue material comes from Namibia. Colorless to pale aqua blue, it is virtually unknown outside serious gem collectors but is prized for its rarity and clean, glassy brilliance.

Care & Durability

- Aquamarine and blue topaz (Mohs 7.5–8) are durable and low-maintenance; safe for ultrasonic cleaning.
- Moonstone (Mohs 6–6.5) is sensitive to scratching and ultrasonic cleaning; use only mild soap and soft cloth.
- Larimar (Mohs 4.5–5) is fragile; keep in protected settings and away from chemicals and abrasion.

Light Blue Gemstones


LIGHT BLUE GEMSTONES
aquamarine
tourmaline
spinel
diamond
indicolite
moonstone
zircon
jeremejevite
apatite
opal
larimar
topaz
DIAMOND BUZZ

CHAPTER 7

Pink Gemstones

Pink gemstones range from the palest blush of rose quartz to the saturated raspberry of rubellite tourmaline. This color family has surged in popularity over the past two decades, led by the extraordinary rise of morganite.

Overview

Pink hues arise from manganese (tourmaline, spessartine), chromium (pink sapphire, ruby — at lower concentrations), iron (morganite), and structural color centers (rose quartz). The boundary between pink and red is subjective and commercially significant: a 'pink ruby' sells for far less than a 'red ruby,' so the distinction is debated by gemologists and auction houses.

Popular Pink Gemstones

Morganite (Mohs 7.5–8)

The pink-to-peach variety of beryl, colored by manganese. Named by Tiffany & Co. in 1910 after banker and gem collector J.P. Morgan. Morganite has experienced a surge in bridal jewelry as a diamond alternative, particularly in rose gold settings where the warm pink-peach tone is accentuated. Large, clean crystals are common, making substantial faceted gems available at accessible prices.

Pink Sapphire (Mohs 9)

Pink sapphire is corundum colored by chromium at levels below those producing ruby's red. The line between pink sapphire and ruby is commercially defined by the GIA as: if the dominant color is red, it is ruby; if pink is dominant, it is pink sapphire. Sri Lanka produces the finest pink sapphires, ranging from pale baby pink to vivid hot pink ('padparadscha-adjacent').

Rose Quartz (Mohs 7)

The most widely available pink gem, rose quartz rarely achieves gem-quality transparent material (usually milky), but its pale pink color and massive availability make it enormously popular in beads, carvings, and cabochons. Its pink color is thought to come from fibrous inclusions of dumortierite or trace titanium, iron, and manganese.

Pink Tourmaline (Rubellite) (Mohs 7–7.5)

Pink tourmalines colored by manganese range from pale baby pink to deep raspberry. The finest, most saturated pinks cross into rubellite territory. Brazil, Nigeria, and Mozambique produce fine material. Pink tourmaline is October's modern birthstone.

Pink Kunzite (Mohs 6.5–7)

The pink-to-lavender variety of spodumene, kunzite is notable for its strong pleochroism and remarkable clarity — large, clean crystals routinely produce spectacular faceted stones above 20 carats. It can fade with prolonged UV exposure (it is sometimes called 'evening stone'). Afghanistan and Brazil are major sources.

Pink Opal (Mohs 5.5–6.5)

Unlike the rainbow-flashing precious opal, pink opal from Peru displays a solid, opaque pink color without play-of-color. It has a distinctly soft, matte appearance and is used in cabochons and carvings. It is associated with calming and emotional healing in crystal lore.

Care & Durability

- Pink sapphire (Mohs 9) is extremely durable and suitable for all jewelry applications.
- Morganite (Mohs 7.5–8) is robust but note: beryl may have inclusions that make ultrasonic cleaning risky.
- Kunzite should be stored away from light to prevent fading; not recommended for rings worn daily.
- Rose quartz and pink opal are best used in earrings and pendants rather than rings due to moderate hardness.

Pink Gemstones


LIST OF PINK GEMSTONES
Pink Morganite
Pink Sapphire
Rose Quartz
Pink Spinel
Pink Tourmaline
Pink Kunzite
Pink Opal
Pink Ruby
Pink Labradorite
Pink Pearl
Pink Topaz
Pink Amethyst

CHAPTER 8

Yellow Gemstones

Yellow gemstones capture the warmth of sunlight. From lemon-pale citrine to the deep amber of hessonite, this color family offers accessible gems at every price point.

Overview

Yellow in gemstones comes primarily from iron impurities or color centers created by natural irradiation. Citrine and yellow topaz both derive their color from iron; yellow sapphire from iron and color centers; heliodor (yellow beryl) from uranium and iron. Yellow was historically associated with gold and thus with royalty and wealth. The canary yellow of fine vivid yellow diamonds — 'canary diamonds' — commands extraordinary premiums at auction.

Popular Yellow Gemstones

Yellow Sapphire (Mohs 9)

Among the most durable yellow gems, yellow sapphire ranges from pale lemon to deep golden yellow. Fine 'pukhraj' sapphires from Sri Lanka are treasured in Vedic astrology as representing the planet Jupiter. Ceylon yellow sapphires are known for their bright, clean golden tones. Excellent hardness and resistance to scratching make yellow sapphire ideal for all jewelry applications.

Citrine (Mohs 7)

The most commercially important yellow gem, citrine is a yellow variety of quartz whose color ranges from pale lemon to deep brownish amber ('Madeira citrine'). Most citrine sold today is heat-treated amethyst or smoky quartz, a treatment so common it is accepted as standard. True natural citrine is quite rare. Brazil is the primary source.

Yellow Topaz (Mohs 8)

Imperial topaz — the rich golden-orange-yellow variety from Brazil's Ouro Preto region — is the most prized, historically reserved for royalty (its name may derive from Sanskrit for fire). Yellow and golden topaz occur naturally in a range of tones. Topaz has perfect basal cleavage, so it requires careful setting to protect against chipping.

Heliodor (Mohs 7.5–8)

The yellow-to-golden variety of beryl (the same mineral family as emerald and aquamarine), heliodor is colored by uranium and iron. Its name means 'gift of the sun.' Fine golden heliodor from Namibia and Ukraine is a collector favorite, often growing in spectacular prismatic crystals.

Amber (Mohs 2–2.5)

Technically not a mineral but fossilized tree resin, amber is nonetheless one of the world's oldest gem materials, used in jewelry for at least 13,000 years. Baltic amber — from the shores of the Baltic Sea — is the most prized; Dominican amber is notable for the frequency of trapped ancient insects (inclusions).

Natural amber is warm, lightweight, and often fluorescent under UV light.

Canary / Yellow Diamond (Mohs 10)

Yellow is the most common fancy color diamond, caused by nitrogen impurities absorbing blue light. 'Cape' diamonds (light yellow) are actually less valued than colorless diamonds, but vivid yellow 'canary' diamonds — intense in saturation — are extremely valuable. The 128.54-carat Tiffany Yellow Diamond is the most famous canary diamond.

Sphalerite (Mohs 3.5–4)

A zinc sulfide mineral with extraordinary dispersion — nearly 3x that of diamond — sphalerite produces spectacular fire in shades of yellow, orange, and red. Almost never seen in commercial jewelry due to its softness and perfect cleavage, it is a serious collector's gem. Fine transparent material comes from Spain and the Congo.

Care & Durability

- Yellow sapphire (Mohs 9) requires virtually no special care; excellent for all jewelry types.
- Citrine and heliodor (Mohs 7–8) are durable but may fade with prolonged heat or UV light; store away from strong sunlight.
- Topaz has perfect cleavage — always set with protective prongs and avoid sharp blows.
- Amber is very soft (2–2.5) and should never be cleaned with anything other than a soft damp cloth; keep away from perfumes and solvents.

Yellow Gemstones


LIST OF YELLOW GEMSTONES
Sapphire
Lemon Quartz
Amber
Diamond
Opal
Garnet
Topaz
Tourmaline
Citrine
Labradorite
Zircon
Moonstone
Calcite
Fluorite
Apatite
Moissanite
Prehnite
Rhodonite
Heliodor
Pearl
Andalusite
Ametrine
Sunstone
Bear Quartz
Serpetine
Fossil Coral
Whisky Quartz
Scapolite
Mariyam
Tiger Eye
Maligano Jasper
Axinite
Bumble Jasper
Phantom Quartz
Cobra Jasper

CHAPTER 9

Black & Grey Gemstones

Black and grey gems carry a timeless, dramatic elegance. From ancient obsidian used to make the sharpest cutting tools in the Stone Age, to the stellar sparkle of black diamond — these stones are far more complex than their muted palette suggests.

Overview

Black color in gems comes from strong light absorption across all wavelengths. This can result from high concentrations of iron and other dark-colored inclusions, graphite, magnetite, or natural irradiation. Grey color often results from labradorescence (in labradorite), structural light scattering (in grey moonstone), or diluted concentrations of the same chromophores that produce black. Black gems have been used in mourning jewelry, protective talismans, and high-fashion jewelry across cultures.

Popular Black & Grey Gemstones

Black Diamond (Mohs 10)

Black diamonds, also called 'carbonado,' are unique among diamonds in being opaque due to millions of dark inclusions (graphite, pyrite, hematite) distributed throughout the crystal. They do not display the traditional brilliance of colorless diamonds but have a distinctive metallic, steely luster when polished. The origin of carbonado is debated — some scientists believe they may have an extraterrestrial origin.

Black Tourmaline (Schorl) (Mohs 7–7.5)

The most common variety of tourmaline, schorl makes up over 95% of all tourmaline found in nature. Its opaque black color comes from high iron content. Used widely in metaphysical circles as a protective stone, and increasingly in contemporary jewelry for its bold, graphic quality. Schorl's striated prismatic crystals are also popular as mineral specimens.

Obsidian (Mohs 5–5.5)

Volcanic glass formed by the rapid cooling of lava, obsidian has been used by humans for at least 700,000 years — first as cutting tools (it fractures with edges sharper than surgical steel), then as mirrors and ornamental objects. Varieties include rainbow obsidian (iridescent layers), snowflake obsidian (white phenocrysts), and Apache tears (rounded nodules). Technically not a mineral as it lacks a crystalline structure.

Black Onyx (Mohs 7)

Onyx is a banded variety of chalcedony; the all-black material sold as onyx is almost always naturally grey chalcedony that has been dyed black (a treatment used since ancient Roman times). Black onyx has been used in cameos, intaglios, and mourning jewelry throughout history. Durable and affordable, it remains a staple of fine jewelry.

Hematite (Mohs 5–6)

The iron oxide mineral with a characteristic metallic silver-grey color and remarkable density. When cut and polished, hematite produces a highly reflective mirror surface. It is known in jewelry as 'black diamond' (incorrectly) and used for beads, cabochons, and intaglios. Ground hematite produces the vivid red of iron oxide pigment.

Labradorite (Mohs 6–6.5)

Though it ranges from dark grey to black in body color, labradorite is famous for its spectacular labradorescence — a vivid play of blue, green, gold, orange, and red iridescence caused by light interference between lamellar twinning. Fine stones from Madagascar display almost the full spectrum. Spectrolite (from Finland) shows the most dramatic color range.

Nuummite (Mohs 3–4)

One of Earth's oldest minerals (approximately 3 billion years old), found only in Greenland. Its black body contains brilliant, iridescent schiller flashes of gold, copper, blue, and violet. Highly sought by collectors and those interested in ancient earth energies.

Care & Durability

- Black tourmaline and black onyx (Mohs 7) are durable for most jewelry applications.
- Obsidian (Mohs 5–5.5) is brittle volcanic glass; protect from sharp blows and avoid ultrasonic cleaning.
- Hematite can rust if exposed to sustained moisture; dry thoroughly after any water contact.
- Labradorite (Mohs 6–6.5) is relatively fragile; best in protected settings like pendants and earrings.

Black & Grey Gemstones


BLACK & GREY GEMSTONES
Diamond
Spinel
Labradorite
Sapphire
Black Rutile
Black Zircon
Black Opal
Moonstone
Hematite
Agate
Pearl
Black Onyx
Hypersthene
Kyanite
Dentric Opal
Tourmaline
Larvikite
Garnet
Obsidian
Tektite
Phantom Quartz
Smoked Opal
Topaz
Moissanite
Alexandrite
Smoky Quartz
Star Diospide
Turtella
Hwak eye
Druzy
Rainbow Moonstone
Flourite
Iolite
Septarian Fossil
Sunstone
Tiger Eye
Indigo Gabbro
Fossil Coral
Basalt
Aventurine
Nuummite
Psilomelna
Shungite
Picasso
Turquoise
Rhodonite
Enstatite
Snowflake
Scapolite Mica

CHAPTER 10

White Gemstones

White and colorless gems are defined not by their color but by its absence — the purity of their transparency and the quality of the light they return to the eye.

Overview

Colorless gems achieve their appearance through extreme chemical purity — the absence of chromophore trace elements. In diamond, absolute purity of carbon produces colorless stones; in sapphire, colorless corundum (leucosapphire) lacks the iron-titanium pairs that produce blue. White gems that are not fully transparent — moonstone, opal, howlite, white coral — achieve their appearance through diffusion, interference, or opacity. Colorless gems are popular as diamond alternatives and as accent stones.

Popular White & Colorless Gemstones

Diamond (Mohs 10)

A colorless diamond of high purity — graded D on the GIA color scale — is the world's most desired gem. Its extraordinary hardness (the hardest natural substance), high refractive index (2.42), and very high dispersion (0.044) combine to produce the unique combination of brilliance, luster, and 'fire' that no other colorless gem fully replicates. Over 80% of diamonds mined are industrial-grade; gem-quality colorless diamonds represent a tiny fraction of production.

White Sapphire (Mohs 9)

Colorless (leucosapphire) is the purest form of corundum. Extremely hard and with good brilliance, white sapphire is increasingly used as a diamond alternative in engagement rings. It does not have diamond's adamantine luster but offers exceptional durability at a much lower price.

Goshenite (Mohs 7.5–8)

The colorless variety of beryl, goshenite was historically used as a glass lens substitute and for making spectacles. The name comes from Goshen, Massachusetts, a historic source. It is the purest form of beryl, free of the chromophores that produce emerald, aquamarine, or morganite.

Moonstone (Mohs 6–6.5)

White moonstone shows the classic blue or white adularescence on a translucent white body. Sri Lanka produces the classic 'blue moon' stones; India produces a rainbow variety. Moonstone is one of the most romantic and poetic gems, associated with Diana (Roman goddess of the moon) and feminine intuition.

White Opal (Mohs 5.5–6.5)

White precious opal displays play-of-color across a light, milky-white background. Australia provides over 90% of the world's white opal, primarily from Lightning Ridge (black opal) and Coober Pedy (white opal). The play-of-color results from the diffraction of light by a regular array of silica spheres within the stone.

Danburite (Mohs 7–7.5)

A calcium borosilicate mineral discovered in Danbury, Connecticut, danburite produces colorless to pale yellow gems with excellent brilliance. Rarely seen outside the collector market, it is an underappreciated gem with good hardness and beautiful luster.

Howlite (Mohs 3.5)

An opaque white mineral with grey veining, howlite is extremely soft and porous, primarily used in beads after being dyed to simulate turquoise or lapis lazuli. Undyed white howlite is also popular in metaphysical jewelry.

Care & Durability

- Diamond (Mohs 10) is the hardest gem but can still chip along cleavage planes from sharp impacts; inspect prongs regularly.
- White sapphire (Mohs 9) is very durable; clean with ultrasonic or steam unless it contains significant inclusions.
- Opal (Mohs 5.5–6.5) contains up to 20% water; avoid prolonged dry conditions, direct heat, and harsh chemicals.
- Moonstone (Mohs 6–6.5) is fragile; best in protected settings; clean only with soft damp cloth.

White Gemstones


LIST OF WHITE GEMSTONES
Topaz
Sapphire
Zircon
Opal
Water Pearl
Goshenite
Quartz
White Rainbow
Cats Eye
Agate
Moonstone
Diamond
Howlite
Danburite
Rutile
White Coral
LabradoriteKING.com

CHAPTER 11

Chromium-Colored Gemstones

Chromium is arguably the most powerful coloring agent in the mineral kingdom. Depending on the host mineral, the same trace element produces the vivid green of emerald, the deep red of ruby, and the chameleon color-change of alexandrite.

Overview

Chromium (Cr^{3}) absorbs light in both the yellow-green and the violet portions of the spectrum, transmitting red and green light. Which color predominates depends on the crystal field strength of the host mineral. In corundum (ruby, pink sapphire), the field is strong enough to tip transmission toward red. In beryl (emerald), the field favors green. In chrysoberyl (alexandrite), the transmission band sits exactly at the boundary between red and green — the sensitivity of human color vision to red versus green wavelengths determines which color we perceive, varying with the light source. This is why chromium-colored gems are considered the most vivid and saturated in nature — chromium creates a narrow, high-transmission window that produces colors of exceptional purity.

Chromium-Colored Gems at a Glance

Emerald — Green beryl

Chromium (and vanadium) replace aluminum in the beryl structure, absorbing red and yellow-orange light. Result: a deep, slightly bluish-green unique to emerald. No synthetic can fully replicate the depth of a fine natural emerald's color.

Ruby — Red corundum

Chromium in corundum absorbs blue-green and violet light. Result: vivid red, often with a fluorescent glow under UV that makes stones appear to light up from within. The same fluorescence makes Myanmar (Burmese) rubies uniquely desirable.

Alexandrite — Color-change chrysoberyl

Chromium in chrysoberyl creates a transmission window balanced between red and green. Incandescent light (richer in red wavelengths) tips perception to red; daylight (balanced spectrum) tips it to green. A perfect alexandrite 'emerald by day, ruby by night.'

Tsavorite — Green grossular garnet

Both chromium and vanadium color tsavorite. The result rivals emerald in intensity but tsavorite is typically cleaner and never needs oil treatments. The gem world's best-kept secret for decades.

Chrome Diopside — Green diopside

An intense green colored by chromium, chrome diopside from Russia's Siberia is vivid but unfortunately relatively soft (Mohs 5.5–6.5). Popular as an affordable emerald alternative.

Chrome Tourmaline — Green tourmaline

Rare chromium-bearing tourmaline produces an unusually intense, warm green distinct from the iron-colored 'verdelite' tourmalines. Fine stones come from Tanzania and Kenya.

Pyrope-Spessartine (Color-Change Garnet)

Some garnets from Tanzania and Madagascar contain both chromium and vanadium in proportions that cause dramatic color changes — green in daylight, red-purple under incandescent light — rivaling alexandrite's color-change effect at a fraction of the price.

Care Notes

- Most chromium-colored gems (ruby, sapphire, alexandrite, tsavorite) are very hard (7.5–9 Mohs) and durable.
- Chrome diopside (5.5–6.5 Mohs) is softer; best in pendants and earrings rather than rings.
- Emerald: always use only mild soap and water — no ultrasonic or steam, as treatments may be dissolved.

Chromium-Colored Gemstones

Gemstones Colored by Chromium

CHAPTER 12

Gemstone Color Wheel

This comprehensive chart presents the full chromatic spectrum of the gem world in a single view — a testament to the extraordinary diversity of color that nature achieves within mineral crystal structures.

Reading the Color Chart

This chart groups dozens of gem minerals by their primary display color, offering a quick visual index to identification by color. A few key observations stand out: **Versatile gems:** Some minerals — tourmaline, garnet, sapphire, spinel, fluorite, quartz — appear across multiple color categories because they occur in almost every hue. This reflects their crystal chemistry's flexibility in accommodating different trace elements. **Single-color gems:** Malachite (always green), rhodochrosite (always pink-red), turquoise (always blue-green), and peridot (always green) have no gem-quality color varieties beyond their signature hue, reflecting more constrained chemistry. **Trade names:** Many gems on this chart are known by trade names rather than mineral names. 'Ruby Zoisite' is zoisite with ruby inclusions (also called anyolite). 'Honey Quartz' is yellow quartz. 'Bear Quartz' is a trade name for smoky quartz from certain sources. Always check the mineralogical name when purchasing.

Notable Gems on This Chart

Moldavite

The only gem on this chart that formed from a meteorite impact. Its distinctive bottle-green color and sculpted surface make it unlike any terrestrial gem.

Charoite

A purple-to-violet silicate found only in Russia's Chara River region, charoite has a swirling, fibrous pattern unique in the mineral world.

Proustite

A silver arsenic sulfide with a deep scarlet-red color, proustite is called 'ruby silver' and is far too soft and light-sensitive for jewelry — it is a collector's mineral specimen.

Sunstone

A feldspar (oligoclase or labradorite) with metallic copper or hematite platelets that create a brilliant spangled effect called aventurescence. Oregon sunstone with strong color and aventurescence is considered a premier gem-quality feldspar.

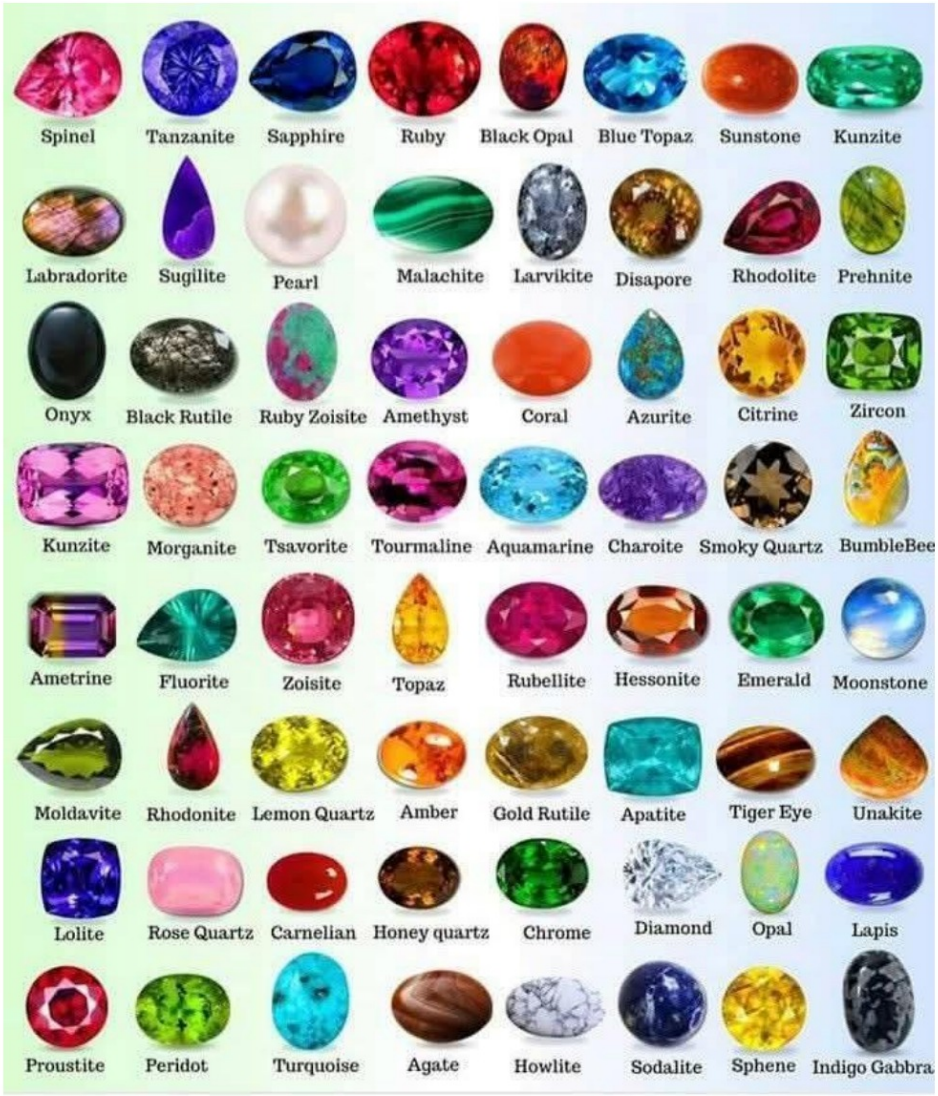
BumbleBee Jasper

Not a true jasper but a carbonate-sulfide rock from Indonesia with vivid yellow, black, and orange banding. Soft and contains arsenic sulfide; handle with care and seal before wearing.

General Identification Tips

- Color alone should never be used to identify a gem — different minerals share colors. Always verify with refractive index, specific gravity, or spectroscopy.
- Be aware that most colored gems in the commercial market have been treated: heated, irradiated, oiled, or filled. Lab reports from GIA, AGL, or Gübelin identify treatments.
- The term 'natural' means formed in nature (not synthetic); it does not mean untreated.

Gemstone Color Wheel


Spinel
Tanzanite
Sapphire
Ruby
Black Opal
Blue Topaz
Sunstone
Kunzite
Labradorite
Sugilite
Pearl
Malachite
Larvikite
Disapore
Rhodolite
Prehnite
Onyx
Black Rutile
Ruby Zoisite
Amethyst
Coral
Azurite
Citrine
Zircon
Kunzite
Morganite
Tsavorite
Tourmaline
Aquamarine
Charoite
Smoky Quartz
BumbleBee
Ametrine
Fluorite
Zoisite
Topaz
Rubellite
Hessonite
Emerald
Moonstone
Moldavite
Rhodonite
Lemon Quartz
Amber
Gold Rutile
Apatite
Tiger Eye
Unakite
Lolite
Rose Quartz
Carnelian
Honey quartz
Chrome
Diamond
Opal
Lapis
Proustite
Peridot
Turquoise
Agate
Howlite
Sodalite
Sphene
Indigo Gabbra

CHAPTER 13

Color Wheel Reference

The gemstone color wheel organizes the mineral spectrum the way a painter organizes pigments — by hue, saturation, and tone — showing at a glance which gems share color families and which occupy unique chromatic territory.

Understanding the Color Wheel

The color wheel arranges gems from red through orange, yellow, green, blue, and violet, with neutral stones (grey, black, white, champagne) at the center. This layout reflects the actual physics of light: adjacent colors share similar wavelengths of light absorption and transmission. A few patterns emerge immediately from the wheel: **The 'Big Three' precious stones** dominate their color quadrants: ruby (red), sapphire (blue), and emerald (green) are the anchors around which other gems are evaluated and described. **Rarity by quadrant:** The blue-violet segment (tanzanite, benitoite, blue sapphire, Paraíba tourmaline) contains some of the rarest and most expensive gems. The green segment is the most diverse. The neutral center (diamonds, moonstone, pearl) represents the 'classic' gems of traditional fine jewelry. **Color change gems** (alexandrite, color-change garnet, color-change sapphire) occupy two positions on the wheel simultaneously, shifting between their daylight and incandescent colors — a unique optical phenomenon that makes them particularly fascinating.

Gems at the Color Extremes

Most Vivid Red: Ruby

Chromium in corundum produces red of unmatched intensity. No other natural mineral achieves ruby's combination of saturation, hardness, and rarity.

Most Vivid Blue: Paraíba Tourmaline

Copper-bearing tourmaline achieves a neon blue-green that appears to emit light — the most electrically vivid blue in nature.

Most Vivid Green: Tsavorite Garnet / Demantoid

Both achieve a vivid pure green. Demantoid's extraordinary dispersion adds fire; tsavorite's saturation rivals emerald.

Most Vivid Orange: Mandarin Spessartine Garnet

Vivid orange spessartine from Namibia and Nigeria has a pure orange unlike any other gem — no brown, no red — just pure spectral orange.

Most Unusual: Alexandrite

Sits between red and green on the color wheel, inhabiting both simultaneously depending on the light source.

Practical Color Matching Tips for Jewelry

- Cool-toned gems (blue, violet, grey) pair naturally with white gold and platinum settings.
- Warm-toned gems (red, orange, yellow, brown) are enhanced by yellow gold settings.
- Green gems sit at the intersection of warm and cool; both yellow and white metals complement them.
- Black gems provide graphic contrast in any metal; white gems offer the most versatile pairing options.

Color Wheel Reference


Ruby
Red Spinel
Garnet
Sunstone
Carnelian
Orange Sapphire
Madiera Citrine
Padparadscha
Fire Opal
Spessartite Garnet
Topaz
Citrine
Yellow Beryl
Golden Pearl
Ethiopian Opal
Yellow Sapphire
Yellow Diamond
Mali Garnet
Green Beryl
Chrysophrase
Peridot
Tsavorite Garnet
Emerald
Tahitian Pearl
Green Sapphire
Green Tourmaline
Alexandrite
Paraiba
Turquoise
Aquamarine
Labradorite
Blue Zircon
Indicolite
Blue Sapphire
Lapis
Blue Spinel
Tanzanite
Chalcedony
Iolite
Purple Sapphire
Alexandrite
Amethyst
Pink Tourmaline
Pink Sapphire
Pink Diamond
Rose Quartz
Morganite
Lotus Garnet
Rubelite
Black Diamond
Grey Spinel
Grey Moonstone
Diamond
South Sea Pearl
Moonstone
Mocha Moonstone
Champagne Diamond
Smoky Quartz

CHAPTER 14

Colours of Tourmalines

Tourmaline is the chameleon of the gem world. No other mineral species produces such a range of color — from achroite (colorless) to verdelite (green), indicolite (blue), rubellite (red), Paraíba (neon blue-green), and even multi-color crystals that display two or three hues in a single stone.

The Tourmaline Mineral Group

Tourmaline is not a single mineral but a group of related boron silicate minerals sharing the same crystal structure — the trigonal system — but varying in chemical composition. The common varieties include: **elbaite** (the gem-quality variety producing most colored tourmaline), **schorl** (black, iron-rich), **dravite** (brown, magnesium-rich), and **liddicoatite** (calcium-bearing, from Madagascar). Tourmaline crystals are striated along their length and often show color zoning — concentric growth bands of different colors visible through the ends of the crystal. The famous 'watermelon tourmaline' shows a red core surrounded by a white zone and a green rim, mimicking a watermelon's cross-section.

Tourmaline Varieties

Paraíba Tourmaline

Discovered in 1987 by Heitor Dimas Barbosa in Brazil's Paraíba state. Colored by copper and manganese, producing neon blue, green, and turquoise. The copper content is extraordinary — it 'saturates' the color beyond what iron or manganese can achieve, giving Paraíba its distinctive glow. Prices exceed $50,000 per carat for fine Brazilian material. Similar copper tourmalines found since in Nigeria and Mozambique.

Rubellite

Deep pink to red tourmaline, colored by manganese. Distinguished from other pink tourmalines by maintaining its red color under incandescent light. Fine rubellite from Brazil's Cruzeiro mine is legendary. Nigeria and Mozambique also produce excellent material.

Indicolite

Blue tourmaline, ranging from pale sky blue to deep teal. Colored by iron. The finest indicolite approaches Paraíba blue in appearance but lacks copper, so it lacks the 'electric' quality. Often cut in emerald or step cuts to maximize color depth.

Verdelite (Chrome Tourmaline)

Green tourmalines colored by iron (verdelite) or chromium (chrome tourmaline). Chrome tourmaline from Tanzania and Kenya displays an unusually intense, warm green with higher saturation than iron-colored varieties.

Watermelon Tourmaline

A bi-color or multi-color tourmaline showing red-pink at the center and green at the rim, separated by a white zone. The color zoning occurs as the crystal grows, with changing chemical conditions in the hydrothermal fluid. Slices cut perpendicular to the crystal axis display the full watermelon pattern.

Bi-Color & Parti-Color

Tourmalines showing two or more distinct colors — side by side or end to end — are called bi-color or parti-color. These result from changes in the growth environment during crystal formation. Custom cuts that showcase both zones simultaneously are a specialty in the tourmaline trade.

Canary Tourmaline

Vivid yellow tourmalines, rare and highly sought. Most yellow tourmaline tends toward greenish-yellow (dravite-influenced); pure canary yellow is achieved in some elbaite crystals from Zambia and Malawi.

Achroite

Colorless tourmaline, the rarest color variety. Virtually unknown in the market but highly prized by collectors for its rarity.

Tourmaline Care

- Tourmaline (Mohs 7–7.5) is durable and suitable for all jewelry applications.
- Some tourmalines — particularly Paraíba — have fractures filled with flux or resin; clean with warm soapy water only.
- Tourmaline is strongly piezoelectric and pyroelectric — it generates electrical charge under pressure or temperature change, attracting dust. Clean regularly with a soft brush.
- Avoid prolonged UV light exposure for rubellite and pink tourmalines, which may fade.

Colours of Tourmalines


COLOURS OF TOURMALINES
Olive
Bi-Color
Pink
Black
Cat's eye
Indicolite
Chrome
Rubellite
Paraiba
Dravite
Verdelite
Parti color
Purple
Canary
Watermeleon
Achroite

CHAPTER 15

Garnet Varieties

Garnet is not a gemstone but a mineral group — at least six distinct species sharing the same cubic crystal structure and general chemical formula, yet producing gem varieties of startlingly different colors, optical properties, and rarity.

The Garnet Group

The name 'garnet' comes from the Latin *granatum* (pomegranate seed), reflecting the deep red color and rounded shape of common almandine and pyrope. But garnet is far more than a red stone: tsavorite is vivid green, mandarin spessartine is orange, demantoid is yellow-green with extraordinary fire, and color-change garnets rival alexandrite. The six main species are: **pyrope**, **almandine**, **spessartine**, **grossular**, **andradite**, and **uvarovite**. Most gem garnets are chemical mixtures (solid solutions) between two or more end-members.

The Six Garnet Species

Pyrope (Mohs 7–7.5)

The 'fiery' garnet. Pure pyrope is magnesium aluminum silicate; chromium produces its vivid red. Bohemian pyrope — small, deep red stones from Czech Republic — was enormously popular in Victorian jewelry. Rhodolite is a purple-red pyrope-almandine mix and is among the most beautiful and wearable of all garnets.

Almandine (Mohs 7–7.5)

The most common garnet, iron-rich almandine produces dark red to brownish-red stones. 'Star garnets' from Idaho and India show four-rayed or six-rayed asterism — a phenomenon caused by oriented rutile needle inclusions.

Spessartine (Mohs 7–7.5)

Manganese-rich spessartine ranges from yellow-orange to deep red-orange. 'Mandarin garnet' from Namibia is a pure vivid orange of extraordinary beauty — named because its color evokes the skin of a mandarin orange. 'Malaya garnet' is a spessartine-pyrope mix from East Africa with exceptional brilliance.

Grossular (Mohs 7–7.5)

The calcium aluminum garnet species, grossular encompasses the widest color range of any garnet: hessonite (cinnamon orange), tsavorite (vivid green), leuco garnet (colorless), mint garnet (pale green), and hydrogrossular (translucent green). Tsavorite — chromium and vanadium colored — is the gem world's top grossular variety.

Andradite (Mohs 6.5–7)

The calcium iron garnet species, andradite produces demantoid (vivid green with extraordinary dispersion — higher than diamond), melanite (black), and topazolite (yellow). Demantoid from Russia's Ural Mountains is

the most valuable garnet per carat; the Russian stones are identifiable by 'horsetail inclusions' of byssolite fibers radiating from chromite crystals.

Uvarovite (Mohs 7.5)

The calcium chromium garnet, uvarovite produces a uniquely vivid emerald green in tiny drusy crystals coating host rock. Individual crystals are almost always too small to facet; uvarovite is used as druse specimens and matrix jewelry. Found primarily in Russia's Ural Mountains and Finland.

Garnet Care

- Most garnets (7–7.5 Mohs) are durable and suitable for rings and everyday wear.
- Demantoid (6.5–7 Mohs) is somewhat softer; best protected in bezel settings.
- Garnets are generally stable to light and chemicals — safe for ultrasonic cleaning unless heavily included.
- Avoid steam cleaning for andradite (demantoid) as heat sensitivity has been reported.

CHAPTER 15 — REFERENCE

Garnet Varieties


GARNET VARIETIES
almandine
pyrope
spessartine
grossular
andradite
uvarovite
DIAMOND BUZZ

CHAPTER 16

The Beryl Family

Beryl is the parent mineral of some of the world's most beloved and valuable gems. Its pure form is colorless and unremarkable; it is trace element impurities that transform beryl into emerald, aquamarine, morganite, and heliodor.

Beryl — The Mineral

Beryl is a beryllium aluminum cyclosilicate with the chemical formula Be■Al■Si■O■■. It crystallizes in the hexagonal system, forming long prismatic crystals — sometimes of enormous size (crystals from pegmatites in Brazil and Namibia weighing hundreds of kilograms are known). Gem-quality beryl forms primarily in granite pegmatites and hydrothermal veins. Its hardness of 7.5–8 and lack of cleavage make it durable for all jewelry applications — an advantage emerald shares with aquamarine and morganite.

The Beryl Family Members

Emerald — Green Beryl

Chromium (and sometimes vanadium) colors emerald. The definition requires that the green be saturated and caused by chromium; pale green beryl is just 'green beryl,' not emerald. Colombia's Muzo and Chivor mines have produced the world's finest emeralds for 500 years. Inclusions are expected and accepted — a gem-quality emerald is almost never eye-clean.

Aquamarine — Blue-Green Beryl

Iron (Fe^{2}■) in the beryl structure produces a range from pale blue to vivid blue-green. Heat treatment converts greenish aquamarine to pure blue by oxidizing iron. The most prized 'Santa Maria' aquamarines from Brazil's Minas Gerais state display a deep, saturated blue that rivals fine sapphire.

Morganite — Pink Beryl

Manganese colors morganite from pale blush to peach to vivid pink. Named in 1910 for J.P. Morgan, morganite has become an enormously popular diamond alternative, particularly for engagement rings. Brazil and Madagascar are key sources; heat treatment removes orange tones, producing the purest pink.

Heliodor — Golden Beryl

Iron (Fe^{3}■) and uranium produce heliodor's yellow to golden color. The name means 'gift of the sun.' Fine specimens from Namibia's Klein Spitzkoppe are among the most spectacular in the world. Unlike emerald, heliodor is typically very clean and brilliant.

Goshenite — Colorless Beryl

The pure, uncolored form of beryl. Historically used to make spectacle lenses, goshenite is rarely seen in jewelry but is prized by mineral collectors for perfect, colorless crystals. It represents the 'base' beryl chemistry.

Maxixe Beryl — Deep Blue Beryl

An unusual deep blue beryl colored by nitrate ions rather than transition metals. Its blue is radiation-induced and unfortunately fades with light exposure — making it a gemological curiosity rather than a commercial gem. Named after the Maxixe mine in Brazil.

Bixbite (Red Beryl) — Red Beryl

The rarest beryl variety, colored by manganese to a vivid raspberry red. Found commercially only in Utah. Gem-quality crystals are tiny; stones above 0.5 carats are exceptional and extremely valuable. It is estimated to be 1,000 times rarer than diamond.

Beryl Family Care

- All beryls (7.5–8 Mohs) are relatively hard and durable with no cleavage — excellent for all jewelry types.
- Emerald: oil or resin filling is standard practice; clean only with mild soap and lukewarm water. Avoid ultrasonic, steam, and solvents.
- Aquamarine, morganite, heliodor: generally stable; safe for ultrasonic cleaning if inclusion-free.
- Store beryls separately to avoid scratching softer gems; their hardness will scratch most other stones.

CHAPTER 16 — REFERENCE

The Beryl Family


GREEN BERYL
EMERALD
AQUAMARINE
MAXIXE BERYL
MAXIXE-TYPE BERYL
BERYL FAMILY
BIXBITE (RED BERYL)
MORGANITE (PINK BERYL)
GOSHENITE (COLORLESS BERYL)
HELIODOR (GOLDEN BERYL)

CHAPTER 17

Pearl Colours

Pearls stand apart from every other gem in this book: they are organic, created by living creatures, and require no cutting or polishing — nature produces the finished gem. They are also the oldest jewelry gem in continuous use, worn for at least 6,000 years.

How Pearls Form

A pearl forms when an irritant — a parasite, tissue fragment, or foreign object — enters a mollusk. The mollusk's mantle tissue responds by secreting nacre (pronounced NAY-ker), a substance composed of microscopic hexagonal tablets of aragonite (calcium carbonate) bound by an organic protein called conchiolin. Layer upon layer of nacre, built up over months or years, creates the pearl. The thickness and quality of the nacre determines the pearl's luster — the most valued quality in a pearl. Natural pearls, formed spontaneously without human intervention, are now extraordinarily rare. Virtually all pearls on today's market are **cultured** — a process in which pearl farmers surgically implant a nucleus (a bead of polished freshwater mussel shell) into an oyster, then tend the oyster for 2–6 years as it deposits nacre.

Pearl Types by Origin

Akoya Pearl

The classic round white pearl with a silver-white or cream body color and high luster. Produced by Pinctada fucata oysters in Japan and China. Akoya pearls are the most familiar type in Western markets — the 'traditional' pearl necklace. They range from 2–10mm; the finest are from 6.5–7.5mm.

South Sea Pearl

Produced by the large Pinctada maxima oyster in the warm waters of Australia, Indonesia, and the Philippines. South Sea pearls are the largest cultured pearls available (10–20mm), with colors ranging from white to silver to golden. Their thick nacre and large size make them among the most valuable pearls per piece.

Tahitian (Black) Pearl

Produced by Pinctada margaritifera in French Polynesia. The only pearl that is naturally dark — ranging from charcoal grey to black with overtones of green, blue, or cherry. Fine Tahitian pearls display a peacock green-to-aubergine overtone that is uniquely beautiful.

Golden South Sea Pearl

The golden color is produced by the 'golden-lipped' variety of Pinctada maxima. Deep gold to champagne in color, golden South Sea pearls from the Philippines and Indonesia command premium prices and are associated with luxury in Asian markets.

Freshwater Pearl

Produced by freshwater mussels (primarily Hyriopsis cumingii) in China's lakes and rivers. Modern freshwater pearls are solid nacre (no bead nucleus), making them more durable than bead-nucleated types. They are available in a vast range of colors, shapes, and sizes at accessible prices. The finest 'Edison pearls' are large, round, and lustrous.

Natural Pearl

Formed spontaneously without human intervention in wild mollusks. Extremely rare since commercial pearl fishing depleted wild oyster populations in the early 20th century. Natural pearl necklaces from historic collections (tested by X-ray to confirm no nucleus) can command millions of dollars at auction.

Pearl Care

- Pearls are soft (Mohs 2.5–4.5) and organic; they are the most fragile gems in common use.
- The rule of last on, first off: apply cosmetics, perfume, and hairspray before putting on pearls. Chemicals etch the nacre.
- Wipe pearls with a soft damp cloth after wearing. Store flat (not hanging) to prevent silk thread stretching.
- Have pearl necklaces restrung every 1–3 years depending on wear frequency; thread weakens with perspiration.
- Never use ultrasonic cleaners, steam, or any chemical on pearls.

Pearl Colours


PEARL COLOURS
white
cream
pink
silver
golden
blue
grey
dark grey
bronze
peacock green
aubergine
black
DIAMOND BUZZ

CHAPTER 18

Mohs Hardness Scale

The Mohs hardness scale is the universal language of mineral durability — a 10-point ranking system devised in 1812 that tells jewelers, geologists, and collectors at a glance how well a gem will resist the scratches of everyday life.

Friedrich Mohs and the Origin of the Scale

Friedrich Mohs (1773–1839) was a German mineralogist and mining engineer working in Austria. In 1812, he selected ten reference minerals and ranked them by one simple test: *can A scratch B?* If mineral A scratches mineral B but B does not scratch A, then A is harder. Mohs chose his ten reference minerals — talc, gypsum, calcite, fluorite, apatite, orthoclase, quartz, topaz, corundum, and diamond — to span the full range of natural hardness. The scale is **ordinal, not linear**. The steps are not equal increments: corundum (9) is about 4× harder than topaz (8), while diamond (10) is approximately 4× harder than corundum (9). In other words, diamond is roughly 16× harder than topaz and over 1,500× harder than talc when measured on an absolute (Vickers) scale.

The Ten Levels Explained

1 — Talc

The softest mineral in existence. Scratched by a fingernail. Soapstone (a talc-rich rock) is carved into figures and bowls. Talc powder is used in cosmetics. No jewelry application — purely a mineralogical reference point.

2 — Gypsum

Can be scratched by a fingernail (Mohs 2.5). Alabaster (massive gypsum) has been carved since ancient Mesopotamia. Selenite (transparent gypsum) produces large, spectacular crystals. Satin spar is a fibrous, silky variety. All are decorative but far too soft for wearable jewelry.

3 — Calcite

The main mineral of limestone and marble, calcite can be scratched by a copper coin. Calcite crystals — Iceland spar, dogtooth, rhombohedral — are collector specimens. Aragonite (same composition, different structure) forms stalactites and pearl nacre. Coral (calcium carbonate) sits near 3–4.

4 — Fluorite

Calcium fluoride, occurring in a full spectrum of colors (purple, blue, green, yellow, colorless). Fluorite is the reference mineral for Mohs 4 and gives us the word 'fluorescence' — many fluorite specimens glow vividly under UV. It is far too soft and cleavable for most jewelry (perfect octahedral cleavage) but is a collector's gem.

5 — Apatite

The Mohs 5 reference mineral. Apatite — calcium phosphate — is the mineral that makes up tooth enamel and bone. It occurs in blue, green, yellow, and violet gem varieties, but is rarely used in jewelry due to its moderate hardness. Neon blue-green apatite from Brazil and Madagascar is a collector favorite.

6 — Orthoclase / Feldspar

The Mohs 6 reference mineral, orthoclase is a potassium feldspar. Moonstone and labradorite are feldspar varieties at this hardness. Gems at Mohs 6 can be used in jewelry but require protective settings; a steel file (6.5) will scratch them.

7 — Quartz

The Mohs 7 reference mineral and the most important benchmark for jewelry durability. **Street dust contains quartz particles.** This means any gem softer than 7 will be scratched by ordinary environmental dust over time — gradually losing its polish. Gems at 7 or above are considered durable for everyday wear. The quartz family includes amethyst, citrine, rose quartz, tiger eye, and agate.

8 — Topaz

The Mohs 8 reference mineral. Hard enough for rings and bracelets with modest care. However, topaz has **perfect basal cleavage** — it can split along a flat plane with a sharp impact — so bezel or protective prong settings are advisable.

9 — Corundum (Ruby & Sapphire)

The Mohs 9 reference mineral. Ruby and sapphire are varieties of corundum — only diamond will scratch them. This exceptional hardness makes corundum the ideal gem for rings worn daily, rivaled only by diamond. Corundum is also used industrially as an abrasive (emery paper).

10 — Diamond

The hardest natural substance known. Diamond is pure carbon in a cubic crystal structure where each carbon atom bonds tetrahedrally to four others, creating an exceptionally rigid lattice. It is approximately 4× harder than corundum on an absolute scale and roughly 1,500× harder than talc. Despite its hardness, diamond is not indestructible — it has cleavage planes along {111} faces and can be chipped by a sharp impact.

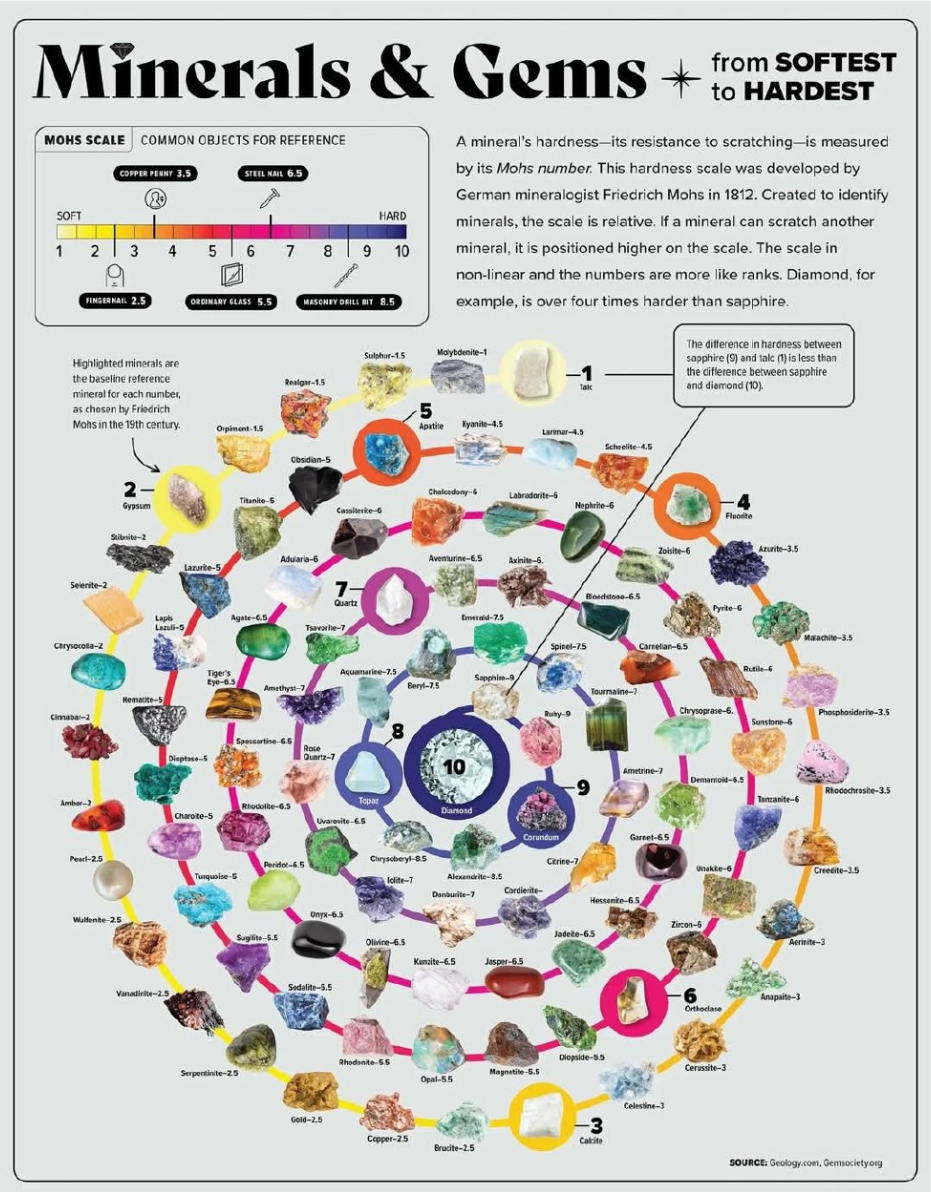
Practical Hardness Guidelines for Jewelry

- Mohs 9–10 (corundum, diamond): Ideal for engagement rings and everyday rings; minimal special care needed.
- Mohs 7.5–8 (beryl, spinel, topaz, chrysoberyl): Excellent jewelry gems; topaz needs protective settings due to cleavage.
- Mohs 7 (quartz, tourmaline, garnet): Good durability for rings; will slowly acquire surface scratches from environmental quartz dust over years.
- Mohs 6–6.5 (feldspar group, tanzanite): Better suited to pendants, earrings, and brooches than everyday rings.

- Mohs 5 and below (apatite, fluorite, opal, pearl): Decorative use only; protect from contact with harder surfaces; best in pendants or display pieces.

- Remember: hardness measures scratch-resistance only. Toughness (resistance to fracture) is a separate property. Jade, for example, is only Mohs 6–7 but is extremely tough due to its fibrous interlocking crystal structure.

Mohs Hardness Scale


Minerals & Gems
from SOFTEST to HARDEST
MOHS SCALE
COMMON OBJECTS FOR REFERENCE
COPPER PENNY 3.5
STEEL NAIL 6.5
SOFT
HARD
1 2 3 4 5 6 7 8 9 10
FINGERNAIL 2.5
ORDINARY GLASS 5.5
MASONRY DRILL BIT 8.5
A mineral's hardness—its resistance to scratching—is measured by its *Mohs number.* This hardness scale was developed by German mineralogist Friedrich Mohs in 1812. Created to identify minerals, the scale is relative. If a mineral can scratch another mineral, it is positioned higher on the scale. The scale in non-linear and the numbers are more like ranks. Diamond, for example, is over four times harder than sapphire.
Highlighted minerals are the baseline reference mineral for each number, as chosen by Friedrich Mohs in the 19th century.
The difference in hardness between sapphire (9) and talc (1) is less than the difference between sapphire and diamond (10).
1 Talc
2 Gypsum
3 Calcite
4 Fluorite
5 Apatite
6 Orthoclase
7 Quartz
8 Topaz
9 Corundum
10 Diamond
Molybdenite–1
Sulphur–1.5
Realgar–1.5
Orpiment–1.5
Obsidian–5
Titanite–5
Cassiterite–6
Stibnite–2
Lazurite–5
Aduiaria–6
Selenite–2
Lapis Lazuli–5
Agate–6.5
Tsavorite–7
Chrysocolla–2
Tiger's Eye–6.5
Amethyst–7
Aquamarine–7.5
Beryl–7.5
Hematite–5
Cinnabar–2
Spessartine–6.5
Rose Quartz–7
Dioptase–5
Rhodolite–6.5
Amber–2
Charoite–5
Uvarovite–6.5
Pearl–2.5
Peridot–6.5
Chrysoberyl–8.5
Turquoise–5
Iolite–7
Alexandrite–8.5
Wulfenite–2.5
Onyx–6.5
Dumortierite–7
Cordierite–
Sugilite–5.5
Olivine–6.5
Hessonite–6.5
Jadeite–6.5
Vanadinite–2.5
Sodalite–5.5
Kunzite–6.5
Jasper–6.5
Serpentinite–2.5
Rhodonite–5.5
Opal–5.5
Magnetite–5.5
Diopside–5.5
Gold–2.5
Copper–2.5
Brucite–2.5
Celestine–3
Cerussite–3
Anapaite–3
Aerinite–3
Creedite–3.5
Unakite–6
Zircon–5
Tanzanite–6
Rhodochrosite–3.5
Phosphosiderite–3.5
Sunstone–6
Malachite–3.5
Rutile–6
Pyrite–6
Azurite–3.5
Zoisite–6
Nephrite–6
Labradorite–6
Chalcedony–6
Larimar–4.5
Ilyanite–4.5
Scheelite–4.5
Aventurine–6.5
Axinite–6.
Bloodstone–6.5
Emerald–7.5
Spinel–7.5
Carnelian–6.5
Sapphire–9
Tourmaline–7
Ruby–9
Chrysoprase–6.
Ametrine–7
Demantoid–6.5
Garnet–6.5
Citrine–7
SOURCE: Geology.com, Gemsociety.org

CHAPTER 19

Gemstone Shapes & Cut Chart

A gemstone's cut is the only factor in the 4Cs (cut, color, clarity, carat) that involves human craft rather than nature. The shape and faceting style a cutter chooses dramatically influences a stone's beauty, character, and value.

The Art and Science of Gemstone Cutting

Gem cutting (lapidary) is the art of shaping a rough stone into a polished gem that maximizes its beauty. The three fundamental considerations are: **1. Light return:** Facets are angled to reflect light back toward the viewer's eye (brilliance). If angles are too shallow or too steep, light 'leaks' through the base. **2. Color optimization:** Some colored gems are cut to maximize color (cutting deeper for lighter stones, shallower for darker stones). The cutter must understand the stone's pleochroism — tourmaline, for example, shows different colors along different crystal axes and must be oriented appropriately. **3. Yield:** Rough gem crystals are expensive; maximizing the size of the finished gem from a given piece of rough is an economic priority. This sometimes conflicts with cutting for maximum beauty.

Standard Cut Styles

Round Brilliant

The modern round brilliant cut — standardized by Marcel Tolkowsky in 1919 — has 57 or 58 facets arranged to maximize both brilliance (white light return) and dispersion (spectral fire). It is the most scientifically optimized cut for colorless gems like diamond. The proportions are so specific that GIA grades 'cut quality' only for round brilliants.

Step Cut (Emerald Cut)

Rectangular outline with large parallel facets (steps) on the crown and pavilion, and cut corners. Designed to highlight color and clarity rather than brilliance — inclusions are more visible in step cuts. The large 'table' facet and parallel facets create a distinctive 'hall of mirrors' effect. Standard for emeralds (where color is primary) and aquamarine.

Princess Cut

A square cut with brilliant faceting on the pavilion, developed in the 1960s. Combines the geometric modernity of a square outline with the light return of the round brilliant. Popular for engagement rings and fancy-colored diamonds.

Cushion Cut

A square or rectangular cut with rounded corners, resembling a pillow (cushion). One of the oldest modern cuts, derived from the 'old mine cut' popular in the 18th–19th centuries. Prized for its romantic, antique appearance and the 'pillow' of light it creates.

Oval Cut

An elongated brilliant cut that creates the visual impression of a larger stone and elongates the finger. Popular for colored gems and diamonds. Must be evaluated for the 'bow-tie effect' — a dark shadow across the center that affects poorly proportioned ovals.

Cabochon

Not a faceted cut but a dome-polished stone with a flat or curved base. Standard for opaque and translucent gems (turquoise, opal, jade), stones with optical effects (cat's eye, star sapphire, moonstone), and soft gems that would chip during faceting. The smooth dome maximizes optical phenomena.

Asscher Cut

A square step cut with larger step facets, designed by Joseph Asscher in 1902. It has an 'X' pattern when viewed face-up. The Art Deco era favored asscher cuts for their geometric elegance.

Trilliant (Triangle)

A triangular brilliant cut. Used as accent stones flanking center gems in 'trilogy' rings and as statement gems in their own right. The corners can be sharp or curved depending on the design.

Choosing the Right Cut for the Stone

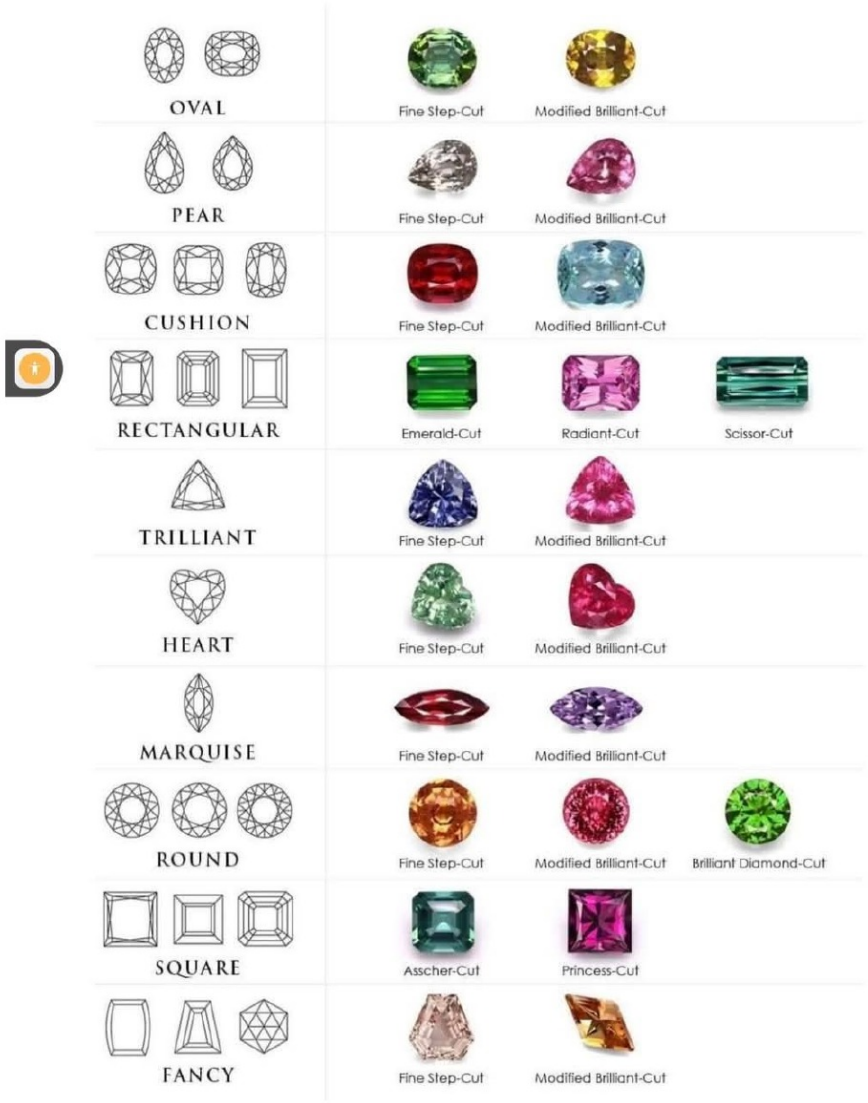
- Transparent, colorless gems (diamond, sapphire, spinel): brilliant cuts maximize light performance.
- Strongly colored gems (emerald, tanzanite, rubellite): step cuts or modified step cuts emphasize color depth.
- Gems with optical phenomena (moonstone, cat's eye, star sapphire): always cut as cabochons to display the effect.
- Included gems or gems with natural features (jardin in emerald, silk in ruby): cutting style should work with — not against — the stone's character.
- Soft gems (opal, turquoise, malachite): cabochon is standard; faceting would chip facet edges quickly.

CHAPTER 19 — REFERENCE

Gemstone Shapes & Cut Chart

GEMSTONE SHAPES & CUT CHART

STANDARD SHAPE COMMONLY ACCEPTED IN THE GEM INDUSTRY



CHAPTER 20

Crystal Systems

Every mineral belongs to one of seven crystal systems — a classification based on the symmetry axes of the crystal lattice. Crystal system determines physical properties: cleavage, optical behavior, and how a gem interacts with polarized light.

Why Crystal Systems Matter for Gemology

Minerals crystallize according to the laws of atomic bonding and geometric packing. The arrangement of atoms into a repeating three-dimensional lattice creates the crystal structure — and the symmetry of that structure defines the crystal system. Crystal system has practical consequences for gemologists: **Optical character:** Cubic (isometric) crystals are singly refractive — light passes through them as a single ray. All other crystal systems are doubly refractive — they split light into two rays traveling at different speeds. This produces the phenomenon of **birefringence**, visible in strongly doubly-refractive stones like calcite (which shows doubled images through the crystal), zircon, and peridot. **Cleavage directions:** Crystals cleave along planes of weakest atomic bonding, which are determined by crystal structure. Cubic fluorite has perfect octahedral cleavage in four directions; orthorhombic topaz has one perfect basal cleavage. Understanding cleavage helps lapidaries cut safely and jewelers protect stones from impact. **Pleochroism:** Only doubly-refractive gems can show pleochroism (different colors along different crystal axes). Strongly pleochroic gems like tanzanite, iolite, and alexandrite must be oriented correctly during cutting to display the desired face-up color.

The Seven Crystal Systems

Cubic (Isometric) — Spinel, Garnet, Diamond, Fluorite

The highest-symmetry system: three equal axes at right angles. Cubic gems are singly refractive (one refractive index) and therefore show no pleochroism. They grow as cubes, octahedra, dodecahedra, and combinations. Cubic crystal symmetry is why diamond octahedra can be cleaved into two gem-quality pieces along the {111} cleavage.

Tetragonal — Zircon, Vesuvianite, Scapolite

Two equal horizontal axes and one unequal vertical axis, all at right angles. Doubly refractive. Zircon's tetragonal structure is why it shows significant birefringence — seen as a doubling of facet edges when viewed through the stone.

Hexagonal — Beryl, Apatite, Quartz (trigonal subset)

Three equal horizontal axes at 60° to each other and one vertical axis. The hexagonal system includes some of the most important gem minerals. Beryl's prismatic hexagonal crystals are immediately recognizable. Note: the trigonal system (including quartz, ruby, sapphire, tourmaline, and calcite) is sometimes classified as a sub-division of hexagonal.

Trigonal — Quartz, Corundum (Ruby & Sapphire), Tourmaline, Calcite

A sub-division of hexagonal, the trigonal system has 3-fold (rather than 6-fold) rotational symmetry. Corundum's trigonal symmetry produces the characteristic hexagonal barrel shape of sapphire and ruby crystals, and the 3-fold symmetry of asterism (six-rayed stars result from three intersecting sets of needle inclusions at 60°).

Orthorhombic — Topaz, Peridot, Tanzanite, Alexandrite

Three unequal axes all at right angles. Topaz's perfect basal cleavage perpendicular to its length is a direct consequence of its orthorhombic structure. Peridot's strong double refraction is also related to its crystal structure.

Monoclinic — Spodumene (Kunzite/Hiddenite), Orthoclase, Jade (Jadeite), Malachite

Two axes at right angles and one inclined axis. Many common rock-forming minerals are monoclinic. Spodumene crystals can reach enormous sizes in pegmatites — the 'Etta spodumene' crystal from South Dakota weighed 90 tons.

Triclinic — Amazonite (Feldspar), Kyanite, Labradorite, Rhodonite

The lowest-symmetry system: three unequal axes, none at right angles. Triclinic gems often show sharp, blade-like crystal habits. Kyanite famously has different hardness values in different directions: Mohs 4–5 along the crystal length, Mohs 6–7 across it — a direct consequence of directional bonding strength in its triclinic structure.

Crystallographic Notes for Collectors

- Identifying crystal system is part of professional gem identification — gemologists use a polariscope to determine singly vs doubly refractive stones.
- Knowing a stone's crystal system reveals its cleavage risk: perfect cleavage gems (topaz, fluorite, diamond) need protective settings.
- The strongest, toughest gems (jadeite, nephrite jade) achieve their toughness despite moderate hardness through interlocking fibrous crystal structures.
- Kyanite's variable hardness (Mohs 4–5 lengthwise, 6–7 crosswise) is a gemological curiosity directly related to its triclinic structure.

Crystal Systems


Cubic
Spinel
Garnet
Tetragonal
Zircon
Hexagonal
Apatite
Beryl
Trigonal
Quartz
Sapphire
Ruby
Orthorhombic
Topaz
Peridot
Tanzanite
Monoclinic
Spodumene
Triclinic
Amazonite