COLORED STONES

Color
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Facing page: This Cartier necklace from the early 1900s is a great showcase for the bold primary colors of the Big 3 gems: ruby, sapphire, and emerald.
COLOR

A superb 10-ct. blue sapphire—rarely seen anywhere but in the finest auction houses—rests between a dealer’s fingers. It’s late in the day and the light is beginning to fade, but the gem still displays its rich, velvety, blue color. Tilting the stone, the dealer quickly evaluates the gem’s cut and sees that it’s a little deep. The dealer’s practiced eye detects other minor problems: Some of the gem’s facets aren’t symmetrical, and there’s a cluster of colorless crystals near its girdle.

None of these details matter as much as the gem’s glorious color. The dealer already has a buyer in mind. All that remains to be negotiated is the price.

Every day, dealers make exceptions for clarity and cut when a gem’s color is truly outstanding. The superb velvety blue of a sapphire can often more than make up for any eye-visible inclusions or less-than-perfect proportions.
Whenever people meet to buy and sell gems, they discuss color as the most important quality factor.

The inclusions are easy to see under this Paraiba tourmaline’s crown, but they don’t detract from its superb color.

Although pink sapphire, tourmaline, garnet, and spinel can all look similar, each gem has its own unique beauty and value factors. Make sure you know a gem’s identity so you can judge it against others of its own species or variety.
Each colored stone species has its own beauty and value factors. An aquamarine and an emerald can’t be judged by the same standards. Buyers judge a gemstone’s beauty by comparing it with other gems in its own species or variety. In this assignment, and the three that follow it, you’ll learn how to evaluate colored stones quickly and accurately. Later, individual gem assignments will provide information to help you make decisions about each gemstone’s value.

DESCRIBING GEMSTONE COLOR

- What are the three components of bodycolor?
- How does the trade use special terms to describe gem color?

The selection of colors in which a gemstone occurs is called its **color range**. Each gem has a different color range, and it can be broad or narrow. For example, most peridot is yellowish green, so it has a limited color range. Tourmaline, on the other hand, comes in almost every color: vibrant pinks and greens, yellows and oranges, and the astonishing electric blue of Paraiba tourmaline.

Within any gem’s color range, some colors are more desirable than others. These top colors fall within limits that are generally accepted in the trade. A gem that features what the trade considers the most desirable color or colors is described as having **fine color**.

Blue sapphire is an excellent example. Although blue sapphires range in color from violetish blue to strongly greenish blue, only a small portion

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Some gems occur in a much wider range of colors than others. Tourmaline’s color range (above) extends across every hue, while peridot’s range (right) is limited to yellowish greens and greenish yellows.
Within each colored stone species, dealers consider some colors to be finer than others. Most buyers prefer rich red hues (above) to dull pink ones (left) in tourmaline.

Dealers prefer sapphires with pure blue hues over sapphires that show a mixture of hues. A green color component tends to reduce a blue sapphire’s value most of all.

Large, fine-color gems are more available in some gemstone species than in others. It’s much easier to find an attractive 5.00-ct. green tourmaline than an equivalent-quality emerald or tsavorite garnet of the same size. Pictured from left to right are two emeralds, a tourmaline, and a tsavorite garnet.

of that range is considered fine color. Sapphires of violet-blue to pure blue are generally considered the best, and are valued much more highly than greenish blue sapphires.

In some gem species, large, fine-color stones are much more plentiful than in others. In sizes above 2.00 cts., fine-color chrome tourmaline is much more available—and therefore a lot less costly—than tsavorite garnet of the same size and appearance. Most tsavorite rough is highly fractured and suitable only for small stones. This makes fine-color tsavorite larger than 2.00 cts. rare and expensive.
The smooth, polished facets of a fashioned stone reflect some of the light that strikes them. The light that’s not reflected enters the stone. The transmitted rays reflect within the gem, exit the stone, and return to your eye as bodycolor.

**Bodycolor**—A gemstone’s basic color, determined by its selective absorption of light.

**Hue**—The first impression of an object’s basic color.

**Tone**—Degree of darkness or lightness of a color.

**Saturation**—A color’s strength or intensity.

When white light meets a colored gemstone’s surface, some rays are reflected and some travel into the gem. The gem absorbs some colors and transmits others. The transmitted rays reflect within the gem, exit the stone, and return to your eye as bodycolor.

**BODYCOLOR**

The smooth, polished facets of a fashioned stone reflect some of the light that strikes them. The light that’s not reflected enters the stone. The white light is split into its spectral colors, and the gem absorbs some of the colors and transmits the rest, or returns them to the viewer.

As you learned in Assignment 4, this process—where some light is reflected, some is absorbed, and some is transmitted—is called selective absorption. The transmitted wavelengths give the gem its basic color, called bodycolor. Bodycolor is a combination of hue, tone, and saturation.
Hue is your first impression of a gem’s basic color. It’s the green of a tourmaline or the blue of a sapphire. Hue might be described as red, orange, yellow, green, blue, violet, or purple.

Some color descriptions might also require a combination of color terms. For example, a ruby might have some blue color zoning that gives it a purplish face-up color, so you’d call it “purplish red.”

This fine peridot’s bodycolor (left) is a rich yellowish green. Designers often combine fine-color gems with contrasting bodycolors for a dramatic effect. The jewelry suite by Verdura (above) features peridot, ruby, and yellow diamonds.
Stones that show a combination of hues face-up are usually less valuable than stones that show a single pure hue. This is the case with sapphire and ruby, for example. Pure blue sapphires are much more valuable than sapphires with green secondary hues, and orange and strong purple secondary hues are less favored in ruby than pure red.

Tone is the darkness or lightness of a color. Many dark-toned stones,
such as dark, “inky blue” sapphires, absorb so much light that they must be cut shallow to yield a lighter looking stone.

Saturation is a color’s strength or intensity. A large part of a gemstone’s value lies in the saturation of its hue. Whether an amethyst’s color is a weak lilac or a rich purple makes a big difference in its value.

In many gems, like tsavorite garnet and amethyst, highly saturated hues might produce dark tones. If the tone is very dark, it might be difficult to assess the gem’s hue. Other gems, like pink sapphire and pink tourmaline,
can reach very saturated hues without becoming dark in tone. In some gems, it’s difficult to decide whether a gem’s bodycolor is the result of a highly saturated hue or dark tone.

Low saturation shows up differently, depending on whether the hue is “warm” (red, orange, and yellow) or “cool” (purple, violet, blue, and green). Generally, warm-colored stones with low saturation look brownish, while cool-colored stones with low saturation look grayish. So descriptions of low saturation levels include either “brownish” or “grayish.” High saturation is described as “strong” or “vivid.”
Hue Wheel

A hue wheel can help you visualize the range of possible gemstone colors. Gem colors are often combinations of hues. For example, blue sapphire's hues can include both violet and green components, and ruby's hues often have a touch of orange or purple.
A three-dimensional model can help you visualize color in transparent gems. First, imagine the spectral colors as a “wheel” or hue circle, running from red (R), through orange (O), yellow (Y), green (G), blue (B), violet (V), purple (P), and back to red.

There’s no color at the center of the circle. The intensity or saturation of each hue increases from the center of the circle until it reaches its strongest saturation at the edge.

Now imagine a column running through the center of the circle, ranging from white or colorless at the top to black at the bottom. This represents the range of tone and adds a third dimension to the color wheel.

You can place the color of any transparent colored gemstone precisely within this three-dimensional color “world.” Stones of light tone and low saturation will be positioned close to the top of the color world, while dark-toned stones of low saturation will be close to the base. Stones with more desirable medium tones and high saturation will be at the “equator” of this imaginary color world.

Because some hues can reach higher saturations than others, the actual color world wouldn’t be exactly globe-shaped, but picturing it that way can help you understand the concept.
The language of the colored stone market contains a sometimes-confusing array of descriptive terms: “Paraíba” tourmaline, “Mozambique” garnet, “Sandawana” emerald, and “Kashmir” sapphire, to name a few. These trade terms, and many others, are widely used in the jewelry industry. Trade terms connect certain words with particular gemstone colors or geographic locations.

Some trade terms describe a gem’s color without hinting at its geographic origin. For instance, “chrome” tourmaline suggests a vibrant green stone of higher quality than the typical green tourmaline, and “hot pink” was used for bright pink tourmaline in the 1980s and 1990s. 

Source names like “Burma” and Kashmir have become synonymous with the finest corundum colors, but these terms should be used only for gems from these specific areas. Sometimes, dealers use trade terms as sales or marketing tools. In an attempt to praise the color, a seller might describe a ruby as Burma color, or a sapphire as the best Kashmir blue, even though they’re not sure of the gem’s place of origin.

You shouldn’t use trade terms that imply a gem’s geographic origin if you can’t be sure of its actual source.

Dealers sometimes describe vibrant pink tourmaline or sapphire as “hot pink.” The term describes a highly saturated but light- to medium-toned pink gem.

Trade terms—Terms often used in the jewelry industry to describe particular gemstone colors or link gems with specific geographic locations.

TRADE TERMS

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If you use terms like Kashmir to describe a fine blue sapphire, or Mogok for vivid red ruby, be sure each of these gems comes from that particular place. If you can’t positively identify a gem’s origin, don’t use these terms.

However, you should be aware that sellers often mix inexpensive gems from many different sources together for sale. For instance, dealers in Bangkok—the world’s corundum marketing center—mix dark blue sapphires from Nigeria, Vietnam, China, and Thailand, and offer them in the trade as “Australian.” They can do this because sapphires from all of
those deposits are very similar, and because their wholesale customers readily accept dark or inky blue sapphire as Australian.

The use of a trade term to describe a fine ruby, sapphire, or emerald might be supported by stronger evidence than just appearance, such as a certificate of origin. Dealers in fine stones sometimes know the geographic origin and history of the gems they specialize in, but might not be as familiar with other gems. If a dealer offers you a fine blue sapphire and describes it as “Burmese,” make sure you can confirm that it actually came from that source.

Ethical dealers take responsibility for the origin of the stones they sell and don’t make claims they can’t support. You’ll learn more about trade terms in the individual stone assignments later in the course.

**USING GIA TERMS TO DESCRIBE GEMSTONE COLOR**

Because gem color descriptions are so varied and subject to individual perception, GIA developed the GIA Colored Stone Grading System to help judge an individual stone’s color. This system blends color science and practical trade information to help you place a stone on a scale from the “most preferred” to the “least preferred” color for its species or variety.

The GIA color system uses 31 hue names. To describe a gem’s color, it combines basic hue names (red, orange, yellow, green, blue, violet, and purple) with any modifying hue names that might be necessary.

GIA developed a shorthand system for this notation. The dominant—or stronger—hue is capitalized. For example, red modified by a slight amount of purple becomes slpR (slightly purplish red). If the purple is
The GIA Colored Stone Grading System includes a description system that uses 31 hue names to describe colored gemstones.
The GIA tone scale helps you judge a gem’s lightness or darkness. Three key standards to remember are (3) light, (5) medium, and (7) dark.

<table>
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<th>Tone Scale</th>
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<tr>
<td>2 3 4 5 6 7 8</td>
</tr>
<tr>
<td>very light light medium light medium dark dark very dark</td>
</tr>
</tbody>
</table>

Use the GIA saturation scale to judge a gem’s strength of color. In warm colors (top row), weaker saturations of 1, 2, or 3 appear brownish. In cool colors (bottom row), the same values look grayish. In both warm and cool colors, gems with saturations of 4, 5, or 6 are almost always more valuable if all other factors are equal.

<table>
<thead>
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<th>Saturation Scale</th>
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<tr>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>grayish slightly grayish very slightly grayish moderately strong strong vivid</td>
</tr>
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</table>

Both by Peter Johnston/GIA

<table>
<thead>
<tr>
<th>HUES</th>
<th>ABBREVIATION</th>
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<tr>
<td>Purple</td>
<td>P</td>
</tr>
<tr>
<td>reddish Purple</td>
<td>rP</td>
</tr>
<tr>
<td>Red-Purple or Purple-Red</td>
<td>RP/PR</td>
</tr>
<tr>
<td>strongly purplish Red</td>
<td>stpR</td>
</tr>
<tr>
<td>slightly purplish Red</td>
<td>slpR</td>
</tr>
<tr>
<td>Red</td>
<td>R</td>
</tr>
<tr>
<td>orangy Red</td>
<td>oR</td>
</tr>
<tr>
<td>Red-Orange or Orange-Red</td>
<td>RO/OR</td>
</tr>
<tr>
<td>reddish Orange</td>
<td>rO</td>
</tr>
<tr>
<td>Orange</td>
<td>O</td>
</tr>
<tr>
<td>yellowish Orange</td>
<td>yO</td>
</tr>
<tr>
<td>orangy Yellow</td>
<td>oY</td>
</tr>
<tr>
<td>Yellow</td>
<td>Y</td>
</tr>
<tr>
<td>greenish Yellow</td>
<td>gY</td>
</tr>
<tr>
<td>Yellow-Green or Green-Yellow</td>
<td>YG/GY</td>
</tr>
<tr>
<td>strongly yellowish Green</td>
<td>styG</td>
</tr>
<tr>
<td>yellowish Green</td>
<td>yG</td>
</tr>
<tr>
<td>slightly yellowish Green</td>
<td>slyG</td>
</tr>
<tr>
<td>Green</td>
<td>G</td>
</tr>
<tr>
<td>very slightly bluish Green</td>
<td>vslbG</td>
</tr>
<tr>
<td>bluish Green</td>
<td>bG</td>
</tr>
<tr>
<td>very strongly bluish Green</td>
<td>vstbG</td>
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<tr>
<td>Green-Blue or Blue-Green</td>
<td>GB/BG</td>
</tr>
<tr>
<td>very strongly greenish Blue</td>
<td>vstgB</td>
</tr>
<tr>
<td>greenish Blue</td>
<td>gB</td>
</tr>
<tr>
<td>very slightly greenish Blue</td>
<td>vslgB</td>
</tr>
<tr>
<td>Blue</td>
<td>B</td>
</tr>
<tr>
<td>violetish Blue</td>
<td>vB</td>
</tr>
<tr>
<td>bluish Violet</td>
<td>bV</td>
</tr>
<tr>
<td>Violet</td>
<td>V</td>
</tr>
<tr>
<td>violetish Purple</td>
<td>vP</td>
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Depending on your location—tropical island or city—the term "sky blue" might describe very different color qualities. In gems, subtle color differences can make big differences in value, so it's important to have a consistent and systematic way to communicate gemstone color.

strong, the designation would be stpR (strongly purplish red). Where the stone shows approximately equal amounts of purple and red, the shorthand is RP/PR (red-purple or purple-red) and both hues are written as capitals. If purple dominates, it’s written as rP (reddish purple).

Tone and saturation come next in the notation. The system divides tone into 11 levels ranging from colorless (transparent) or white (opaque)—designated as 0—through increasingly darker grays to black—designated as 10.

In practice, only levels 2 (very light) through 8 (very dark) apply to transparent colored stones. Tones that are any darker or any lighter are
nearly impossible for the human eye to detect. Three standard tone levels are 3 (light), 5 (medium), and 7 (dark). With a little practice you can estimate the values between them.

The saturation scale has six levels. If the hue has any brownish or grayish components, saturation is 3 or lower. If brown or gray appear distinctly, saturation is 1 or 2. If there’s only a slight hint of brown or gray, then saturation is around 3. At level 4 and above, there’s no trace of brown or gray, and the hue’s strength increases through levels 4, 5, and 6. A saturation rating of 4 or higher makes an attractive colored stone, all other things being equal.

For most colored stones, the most valuable colors tend to fall within medium-light to medium-dark tone (4, 5, 6) and moderately strong to vivid saturation (4, 5, 6).

Putting the notations all together, you might end up with a gemstone described like this: vslgB8/3 (very slightly greenish blue—with blue the dominant color—with very dark tone and very slightly grayish saturation). The advantage of a description like this is that it means the same thing to everyone. This makes it an improvement over terms like “sky blue,” or “midnight blue,” which could be open to a variety of interpretations.

**FACTORS THAT AFFECT A GEM’S BODYCOLOR**

- How does a gemstone’s cut influence its face-up color?
- What causes windows and extinction?
- How do color zoning and pleochroism influence a gem’s color or appearance?
- How do clarity and fluorescence affect a stone’s color?

Just because a rough crystal looks promising when it comes out of the ground or the streambed, doesn’t mean it will end up as a dazzling gem. Many things can get in the way of this, including the gem’s own internal structure and clarity characteristics. Add to this the challenge of making just the right cutting decisions, and you’ll realize that a richly colored finished gem is no accident—it’s all about the way the gem and the light interact.

**CUT**

A master cutter unlocks the beauty within a 100-ct. rough peridot crystal from Pakistan, resulting in a 10-ct. cushion cut. Testifying to the cutter’s skill, sharp reflections ripple across the gem’s perfectly positioned facets as the stone moves. The gem’s entire surface is a beautiful, rich green, with no obvious dark or light areas.

Cutters work with what nature offers, and a cutter has to examine a rough crystal very closely before making the first cut. Every piece of rough has its own unique pattern of color distribution, which is the amount of color and its location in the crystal. The blue color in a rough sapphire, for example, might be located only at the tips of the crystal.
KEY Concepts

The way a gem is cut can have a dramatic effect on its face-up color.

Expert cutters can improve the color of even the finest-quality rough. A skilled cutter achieved a greater strength of color in this superb 64.57-ct. peridot than was apparent in the original rough crystal.
An evenly colored piece of rough can produce finished gems of different colors, depending on their sizes and proportions. The color of a gem cut from light-colored pink topaz rough, for example, is attractive enough only if the gem is above a certain size. The cutter might decide to cut one large, deep stone rather than a few better-proportioned—but more lightly colored—smaller stones.

Skilled cutters also consider color that’s arranged in layers parallel to the crystal faces or near the crystal’s surface. They try to cut the finished stone to show the best possible color through the crown. To accomplish this, they can arrange colored layers so they’re parallel to the faceted gem’s girdle, or locate strong color in the culet.

Correct proportions can maximize brilliance and color, but as you’ll see, it isn’t economically possible or desirable to cut every piece of rough to perfect proportions.
The cutter’s primary goal is to produce a stone with the highest possible value. Often, that means getting the best weight return from the rough. To produce an attractive stone, the cutter must often balance economics and art. This is especially true when the rough is expensive and rare.

Some people might think a cutter would try to get the largest possible finished stone from a large piece of dark red garnet rough, but that’s often not the case. Experienced cutters know that large stones cut from dark material appear almost black, and customers want garnets that look red face-up. It would be better to cut several small gems from the same piece of rough. The small gems would be much more attractive.

Cut variations are accepted in gems fashioned from flattened rough, like some rubies. The flatness of the rough limits the possible depth of the finished stone’s crown and pavilion. People in the trade recognize that cutting variations in this type of material represent the best possible balance of fine color and weight retention.

With expensive stones, compromises made to save weight reflect a cutter’s ability to produce usable faceted stones out of very challenging materials. If the rough is very valuable, loss of weight equals loss of money. Cutters can’t afford to lose gem weight by cutting to correct proportions. And some very fine rough can produce excellent color even if the stone’s proportions are not perfect.

Windows and Extinction

When light escapes through the back of a shallow stone, it creates a window or “see-through” area of low color saturation. If you place a shallow gemstone—or some poorly cut ones—face-up on a page and you can read text through the crown, it’s a result of windowing.
Shallow cutting results in loss of light. Light entering the stone’s crown from above meets the pavilion facets at the wrong angle and exits the stone without being reflected back to the eye. And because the pavilion is shallow, light from below travels through the pavilion and exits through the crown. Because the light has only a short distance to travel through the stone, the color is less intense than if the stone were cut to excellent proportions.

With a stone of very shallow proportions, the windowed area might dominate the stone’s face-up appearance. This gives the stone a washed-out look under the table. The hue and tone might not differ much from the rest of the stone, but the saturation would be two to three levels lower. If the windowed area is 50 percent or more of the face-up area of the stone, its color becomes the stone’s bodycolor.

Less expensive stones are often flattened and windowed when the rough limits the depth of the stone. Often, the only way to create a good-sized finished stone is to limit the depth of the pavilion and cut it in a flattened shape. This is the case with most Thai rubies.

At the other extreme are chunky stones with extremely deep pavilions, called “native cuts.” They’re often designed purely to get the maximum weight out of a piece of rough, regardless of color or proportion. Sometimes, this is necessary because of export restrictions imposed by the colored stone’s source country. Some countries allow only cut stones to be exported. Crude cutting that doesn’t remove much of the original rough can be one way to meet the legal requirements and allow the stone to be exported.

Stones with pavilions that are too deep have unattractive dark areas when you view them face-up. This is known as extinction. Areas of extinction shift when you move the gem. Extinction darkens the bodycolor of a gem and can lower its quality and value.

Extinction is a result of the cutting process, and all stones display some extinction at some viewing angles. Light enters the crown facets, reflects off one side of the pavilion, and escapes through the other side of the pavilion instead of through the crown.

**KEY Concepts**
Cutting compromises that save weight can also cause extinction, windows, or both.

**Extinction**—Dark areas in a faceted transparent colored stone.
Cutters don’t always try to prevent extinction. Kunzites and pale amethysts, for example, are often cut deep. The deeper cut allows stronger absorption of the light that travels through the gem. This makes the gem’s color more distinct, and the resulting extinction also makes the stone appear darker.

When light escapes through the pavilion in an uncontrolled way, as with windowing and extinction, it’s called *unplanned light leakage*. When light enters through a stone’s crown, reflects off the inside of the pavilion facets and exits back through the crown to your eye—as the cutter intended—it’s known as *planned light leakage*. You’ll learn more about the interaction of light with a gemstone’s cut in Assignment 9.

**Unplanned light leakage**—Light that exits through the pavilion in an uncontrolled way due to compromises in a gem’s proportions.

**Planned light leakage**—Light that exits through a gem’s crown in a controlled way due to the correct proportions of its cut.

A finished gem’s proportions can have a dramatic effect on its final face-up color. Shallow gems (top) appear lighter because a lot of light escapes through their pavilions. Light entering from below causes a window, or area of lower color intensity. Correctly cut gems (center) show richer color because much of the light that enters the gem reflects off the pavilion and returns to your eye. Deep gems (bottom) appear dark because a lot of light is lost through their pavilions. Loss of light creates areas of extinction, visible through the crown.

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COLOR ZONING

Often, a rough gem’s color isn’t well distributed and the cutter has to compromise to capture whatever color is present. Blue sapphire and amethyst often have areas of strong color, usually parallel to their crystal faces. This is called color zoning, and it’s caused by variations in conditions and coloring agents that occur during crystal growth.

Color zoning appears as areas of uneven coloration or different colors seen from the same viewing direction. Dark-toned sapphires from some types of deposits often contain very strong, angled color zoning, made up of distinct bands of different colors or different color intensities. You’ll frequently see strong color alternating with almost colorless bands. The tone of these sapphires is usually dark enough to conceal the color zoning.

Skilled cutting can reduce the effects of color zoning. In amethyst, prominent zoning can be oriented so the bands of color run parallel to the girdle plane. Strong color zoning in amethyst—even in the top grades—is usually acceptable as long as it can’t be seen through the gem’s crown.

In color-zoned crystals, the cutter can concentrate the color in a small area, usually as close to the culet as possible. Even if the rest of the stone is much lighter or even colorless, this gives remarkably even face-up color. If there’s face-up color zoning that the cutter was unable to conceal, it’s called unintended color zoning and considered a clarity characteristic.

Sometimes, the concentration of trace elements changes abruptly as a gem grows. In some gems, this change of trace-element chemistry results in a change of color during growth. This gives the stone two or more distinct color zones. If the contrast in color is striking, the cutter can cut the gem to make the most of this feature. Gems like ametrine and bicolor tourmaline can be deliberately fashioned to show color zoning. The GIA system describes this as intended color zoning, because it’s part of the finished stone’s unique appeal.
PLEOCHROISM

As you learned in Assignment 4, doubly refractive stones can show different colors through the crown. In most directions within certain transparent, colored, doubly refractive gems, light is split into two separate rays, which might show as different bodycolors, depending on the cutting orientation and viewing angle. This is called pleochroism.

In stones like andalusite, iolite, and tanzanite, pleochroism is visible to the unaided eye. Andalusite, for example, can be cut to show its unique mix of yellow-green and orange pleochroic colors through the crown. And tanzanite can show a more bluish or more violet face-up color, depending on cutting orientation.

For some pleochroic gems—like ruby, tourmaline, and sapphire—some pleochroic colors are less desirable than others, so the rough must be oriented properly before cutting to show the best face-up color in the fashioned gem. In ruby and sapphire, fortunately, the orientation that gives the most favorable color is also the orientation that gives the maximum weight yield.

Blue sapphire, for example, shows its best pleochroic color if the table facet is cut at right angles to the crystal’s length. If it’s cut with the table facet parallel to the crystal’s length, it might show a less-desirable greenish blue face-up color. Even if the stone is correctly oriented, some pleochroism will be visible through the table facet due to the reflection of light rays within the gem.
Some singly refractive stones—spinel, for instance—can show a second color face-up. This isn’t pleochroism. It happens when light that’s reflected within the stone interacts with light that’s transmitted through it. If you check with a dichroscope, you’ll see only one color at a time.
Inclusions that disrupt the path of light through a faceted gem reduce brilliance and color intensity. But some inclusions can have a positive effect on appearance. Fine inclusions can scatter light within a faceted stone and make extinction much less noticeable. Stones with a slightly diffused, or “sleepy,” appearance, like some sapphires, show this effect.

Inclusions can also give a gem its color. Bright particles of green mica give aventurine quartz its green bodycolor, and inclusions of brownish hematite add depth to the color of some yellow sapphires.

Some colored gems contain a multitude of tiny inclusions that scatter light. This gives them a soft appearance. Dealers often describe gems with this property—like this suite of corundum—as “sleepy.” A sleepy gem might have reduced color and brilliance, but it often displays much less extinction than a completely transparent one.
FLUORESCENCE

Fluorescence happens when a material emits visible light—glows—when it’s exposed to invisible ultraviolet (UV) radiation. Sunlight and fluorescent lamps emit some UV radiation, and many colored stones fluoresce in response to it.

Fluorescence adds an extra glow to red spinel’s appearance. It also boosts the red bodycolor of chromium-rich rubies, sometimes enough to counteract extinction. But rubies from some sources are rich in iron, and the iron content inhibits the fluorescent effect. In general, fluorescent rubies are more highly valued than non-fluorescent ones, even though one side effect of fluorescence is a loss of brilliance. You’ll learn more about rubies in Assignment 12.

COLOR CHANGE

As you learned in Assignment 4, color change is a noticeable change in gem color that occurs under different types of lighting. Chromium and vanadium are the coloring agents usually responsible for color change in gems.

Color change occurs in alexandrite chrysoberyl, color-change sapphire, and color-change garnet because these gems transmit the red and green colors of the spectrum almost equally. These gems show different body-colors, depending on the type of light they’re viewed under. For example, an alexandrite appears red under incandescent light, which is rich in red. Under many fluorescent light sources, which are richer in blue and green, it appears green.

Although the hue is different under each light source, the tone and saturation are usually similar. When you judge color-change gems,
examine them under daylight-equivalent light first, then switch to incan-
descent. Consider the extent and intensity of the color change. In alexan-
drite, a distinct green to red change is very highly valued.

PRACTICAL COLOR GRADING

- What should you look for when judging a gem’s color?
- What conditions are important for effective color grading?
- What steps should you take to grade a colored stone?

When you look at a colored stone, all the information you need to assess its quality is there in front of you. The gem’s color, cut, clarity, and carat weight are the key indicators of its value. The first of these judgment factors—color—is the focus of this assignment. You’ll learn about the rest in the next three assignments.

During the color-grading process, a grader asks these questions:

- Is the stone light, medium, or dark in tone?
- What is the gem’s bodycolor?
- Is the saturation weak, moderate, strong, or vivid?
- Is the stone’s color exceptional or poor for that gem species?

When you grade or match colored gems, it pays to keep conditions consistent. Use a neutral background and examine all the gems at the same distance from the daylight-equivalent light source. If you use natural light, try to grade gems around the same time every day.
A sample stone can help you understand the three-step process involved in determining a gem’s color. First, determine if the gem is light, medium, or dark. Second, consider the gem’s hue. This one is green, with just a touch of blue, so the gem is very slightly bluish green. Finally, determine how much color the gem has. This one doesn’t appear even slightly grayish, so it has strong to vivid saturation. The end result is a notation like this: vslbG 5/6.
Colored stone grading isn’t just a matter of filling in a lab report or a worksheet. It’s mostly a tool for making buying decisions. Whether a gem is a single loose stone, part of a parcel, or a centerpiece in finished jewelry, it’s judged by its qualities: the beauty of its color, the precision of its cut, the presence or absence of inclusions, and its size and rarity.

Whether you’re an appraiser, a manufacturer looking for consistency when ordering colored stones, or a retailer trying to match a customer’s existing gem, you grade colored stones every day.

**LIGHTING AND CONSISTENCY**

One of the most important aspects of buying and grading colored stones is the type of lighting you use. For consistency, you should view colored stones under daylight-equivalent fluorescent lighting whenever possible.

Don’t buy stones under lighting that’s too red or too blue. Incandescent lighting with its high yellow and red content will flatter stones that transmit these colors. Ruby, red garnet, spinel, fire opal, and red tourmaline all look better under incandescent light. If you use an incandescent light to look at blue sapphires—which absorb red light and transmit blue light—they won’t look their best.

If you’re buying an important stone, check it under a variety of light sources. When you grade a stone for sale or purchase, try to see it through the eyes of its final judge, the consumer.

A sapphire that looks slightly dark in the strong light of a city like Bangkok or Nairobi—both close to the equator—will probably look inky and black in the less intense light of northern cities like New York or London.

It might be difficult for you to detect slight color variations when you’re out of your own familiar surroundings. For instance, it’s hard to make distinctions in hue with pale stones like aquamarine. The color might look fine at the dealer’s office, but might have a greenish hue when you look at it under your own conditions.

When you know you won’t be able to control the lighting conditions, make sure you take comparison stones of known color or standardized color samples along with you. You can compare them with the new stones under the same light and make a good grading judgment.

If you’re buying stones for a specific customer, it’s best to have a number of sample stones. Get your customer to approve one, leave one at your office, and take one or two with you when you go on a buying trip. You might even want to leave a sample with a reliable dealer so you can conduct future transactions by mail.

Your grading procedures should be consistent. If you always grade colored stones 12 inches from your light source, stay with the practice. The strength of the illumination drops quickly with distance, and this can affect your judgment of gemstone color. If you use natural lighting, try to grade at the same time each day.
Make sure you follow these simple procedures. It’s the best way to make sure that your grading will always have reliable and repeatable results.

Making gem purchases in the same place and at the same time of day are the best ways to have consistent results (top). Color-comparison samples are essential for gems like aquamarine, where prices rise with subtle increases in saturation. Each of these aquamarine samples (bottom) represents a dealer’s grade. The most saturated blue stone is worth about 10 times more than the least saturated one.
HUE, TONE, SATURATION, AND VALUE

Judging colored stones is different from judging colorless to near-colorless diamonds, where absence of color is a defining virtue. Diamond graders focus on clarity—the presence or absence of inclusions—along with the precision and quality of the cut and the presence of even slight color. Fancy-colored diamonds are more like colored stones in that they’re judged primarily on their color, and issues of clarity or perfection of cut are secondary.
Like colored diamonds, vibrant color is the chief glory of most colored gemstones. Because individual gemstone species have characteristic color ranges, it’s important to know a gem’s identity before you grade it. The color of a particular stone should be judged against other stones of the same species or variety, so there are consistent standards for hue, tone, and saturation. It’s no good judging a stone as a poor ruby when it’s actually a pretty good garnet.

Before you look at the color of a gem, clean the stone thoroughly with a gemcloth. Make sure its surfaces are free from fingerprints and dust. Pick the stone up by its girdle with your tweezers, or place it on a neutrally colored—white or gray—surface.

Evaluate the stone’s overall tone—its level of lightness or darkness. To judge tone, consider the stone as a whole. Look at it in the face-up position, and “average” all the different areas you see. Look for a general impression: Does the stone appear light, medium, or dark?

Next, assess the bodycolor and identify the hue. Although this is not always quite as easy as it sounds, ignore surface reflections, areas of extinction, and minor windows.

Here’s a handy tip: If the stone isn’t mounted, turn it onto its table—on a neutral background—and look at the color through the pavilion. This eliminates some of the reflection and scintillation, and makes it easier to see color. Now look at the stone face-up, and look for the same color you saw on the pavilion. Look for the representative color of the stone apart from the darker areas caused by extinction and the lighter areas caused by reflection or windowing.
Now that you’ve identified the stone’s hue and tone, consider the saturation, or strength, of the hue. If it’s a cool color like green, blue, violet, or purple, does it look grayish? If it’s a warm color like red, orange, or yellow, does it look brownish? If you can’t see any gray or brown, then the saturation is moderately strong or higher.

Low saturation and light tone generally give a colored stone low value. The small, calibrated aquamarines used in mass-market jewelry might be almost colorless. The least expensive grades of amethyst are a pale lilac hue, which is a low saturation of purple. Compared to vibrant purple top-grade amethysts, they can look like an altogether different gem species.
Hues at opposite extremes of the tone range—very light or very dark—commonly don’t reach levels of saturation as high as those in medium tones. Dark-toned stones might have high saturation, but they absorb light so strongly that you can’t see the saturation under ordinary lighting conditions. Although you can appreciate the color of gems like these only by shining a light through them, you should grade them under normal lighting.

It’s difficult for your eye to detect hues of low saturation. Weakly saturated hues in inky blue sapphires, dark red garnets, and dark green tourmalines are hard to detect because of dark tone. Low saturation and dark to very dark tone almost always indicate low value.

KEY Concepts

In general, attractive colored stones tend to have highly saturated hues and medium to medium-dark tone.

Hues with very light or very dark tone usually don’t reach the same high levels of saturation as those with medium tone.
Larger stones can appear more saturated than smaller stones cut from the same rough. Aquamarine rough that produces superb stones of 5.00 cts. and above might produce pale, near-colorless smaller stones. Gems such as imperial topaz, morganite (pink beryl), kunzite, and aquamarine achieve the best, most saturated hues only in larger sizes.

Size also matters for some gems. Larger stones can appear more saturated than smaller stones cut from the same rough. Aquamarine rough that produces superb stones of 5.00 cts. and above might produce pale, near-colorless smaller stones. Gems such as imperial topaz, morganite (pink beryl), kunzite, and aquamarine achieve the best, most saturated hues only in larger sizes.

Some stones have intensely saturated color that would be too dark in large sizes, so they’re better as smaller stones. Emeralds from Sandawana, Zimbabwe, make excellent small, calibrated squares and rounds because they show color even down to 2 mm in size. Stones above 1.00 ct. are comparatively rare, and they’re often too dark in tone to be considered really fine.
Blue sapphires from Pailin, Cambodia, also display their strongly saturated color best in smaller sizes, typically below 2.00 cts. Small rhodolite garnets can be a vivid, rich purplish red. In general, a gem becomes more valuable as its saturation increases. Value increases most strongly between moderately strong (4) and vivid (6) saturation, when a gem’s tone is medium (5) to medium dark (6).

**USING YOUR COLOR KNOWLEDGE**

Many factors go into your assessment of a gemstone’s color. Is the tone light, medium, or dark? Is its saturation weak, moderate, or strong? Does the color fall within a range preferred by the gem trade?
Rough is often heavily color zoned, so a stone might show areas of different face-up colors. The color you see face-up is often the result of the cutter’s ability to use very localized areas of color within the rough. Most of the defects in colored stone proportions—for example, windows and extinction—are compromises made by the cutter to produce economically viable stones.

Some stones, such as sapphire, ruby, and tanzanite, show pleochroism. Correct orientation of these stones can yield the best possible face-up color.

The hue and saturation ranges of many gemstone species overlap. It’s possible to offer some gems as lower cost alternatives for the Big 3 and other expensive gemstones that have similar colors.

A fine 5-ct. tanzanite can resemble the finest Kashmir sapphire, but can wholesale for hundreds of dollars per carat instead of tens of thousands of dollars per carat. A suite of emerald jewelry, out of the reach of all but the wealthiest consumers, can be reproduced using tsavorite or chrome tourmaline for far less than the original piece. If a showy ruby pendant is beyond your customer’s budget, try rubellite tourmaline, or even rhodolite garnet.

Try to examine the gems you buy or grade under a consistent light source. If you’re on a buying trip to Bangkok for a customer in New York, think of the lighting conditions you’ll examine the stones under. Remember that natural light varies widely, and rely on your own color samples for grading.
In this assignment, you’ve seen that color is a vital part of gemstone value. In the next assignment, you’ll learn how the intricacies of cut go hand-in-hand with color. Think of a gemstone as the sum of its parts. Each part makes a contribution to your assessment of the gem. The more the stone “tells” you about its features, the better your judgment of its quality, beauty, and value.

KEY Concepts

Most defects in colored stone proportions are compromises made by the cutter to produce economically viable gems.

Many gemstone species share some of the same hue and saturation ranges.
Dealers often have a bewildering array of grades and prices that make it difficult to know what quality of color to expect in stones at various market levels. A good example of this is blue sapphire, which comes in a range of qualities and price levels.

When you picture the market categories for sapphire—or any gem—imagine a pyramid, with commercial-quality gems at the base, middle-market stones in the center, and fine-quality stones at the peak. The ranges of hue, tone, and saturation narrow as you get closer to the top of the pyramid. The number of available stones also narrows dramatically with each increase in quality.

At the commercial level, you can expect to see two broad types of blue sapphire: very dark-toned stones of inky or blue-black appearance and light-toned stones with low saturation and a grayish appearance.

Dark material is much easier to match and more consistent in appearance. It’s good for large orders or catalog sales, where uniformity is important. Dark-toned stones hide their hues and their clarity. Dark-toned sapphires can conceal color zoning and concentrations of silk. Cut and proportion won’t matter as much as the fact that not much light is being transmitted through the stone. For the same reason, the quality of polish on the pavilion matters less than the quality of polish on the crown. Brilliance is low in dark-toned sapphire.

In practice, lighter sapphires are harder to match, with the result that parcels might differ slightly in appearance. In other words, you might request the same size, shape, and price per carat, but receive goods with slightly different hue, tone, or clarity. This can be a problem for a client who expects uniform goods.
The GIA Colored Stone Grading System provides a systematic, repeatable method for noting the quality of colored stones. In commercial blue sapphire, expect to see the widest hue range from violet through very strongly greenish blue (V to vstgB). Expect to see a range of tone from 2 through 8, but less of a saturation range. Saturation from 1 to 4 would be typical.

Dark-toned commercial sapphire might be noted like this under the GIA system: V8/1, bV8/3, vB7/3, B6/2, vslgB8/3, gB8/1, vstgB8/3. Light-toned commercial sapphire might be noted as V2/2, bV2/3, vB3/3, B3/1, or vslgB2/2. Stones at this commercial level form the base of an imaginary quality pyramid.

Middle-market blue sapphires display a narrower range of hues than commercial sapphires. They usually range from violet to very slightly greenish blue (V to vslgB). Their ranges of tone (from 3 through 7), and saturation (3 through 5) are usually also narrower. Some examples of this category might be bV6/4, vB4/4, B5/4, and vslgB7/5.

The finest blue sapphire is at the top of the quality pyramid. Hue range is very narrow, from violetish blue to pure blue (vB to B), with pure blue the preferred hue. Tone (4 through 6) and saturation (5 to 6) also occupy narrow ranges. Examples might be vB6/5 and B6/6.

Remember that these categories are only suggestions and that they might change over time with supply and demand or discovery of new sources.

Variations in hue, tone, and saturation decide a gem's value. For example, although blue sapphires occur in a range of hues from violet to strongly greenish blue, dealers set the highest value on pure blue or violetish blue gems with strong to vivid saturation and medium-dark tones. Dark tones and greenish blue hues reduce a sapphire’s value most dramatically.
You should judge a gemstone’s beauty and value only by comparing it with others of its own species or variety.

Large stones with fine color are more common in some colored stone species than in others.

In many gemstone varieties, pure hues are more valued than mixed hues.

You shouldn’t use trade terms that imply a gem’s geographic origin if you can’t be sure of its actual source.

The way a gem is cut can have a dramatic effect on its face-up color.

The cutter’s main goal is to produce a stone with the highest possible value.

If rough is very valuable, cutters often compromise on proportions to save weight and avoid loss of money.

 Cutting compromises that save weight can also cause extinction, windows, or both.

 When you can’t control the lighting conditions in a buying situation, use your own comparison stones or color samples.

Consistent procedures are very important when grading colored stones.

Know a gem’s identity before you grade it.

In general, attractive colored stones tend to have highly saturated hues and medium to medium-dark tone.

Hues with very light or very dark tone usually don’t reach the same high levels of saturation as those with medium tone.

Larger stones can appear more saturated than smaller stones cut from the same rough.

Some stones reach fine color only in large sizes, others only in small sizes.

Most defects in colored stone proportions are compromises made by the cutter to produce economically viable gems.

Many gemstone species share some of the same hue and saturation ranges.
Key Terms

**Bodycolor**—A gemstone’s basic color, determined by its selective absorption of light.

**Color range**—The selection of colors in which a gemstone occurs.

**Color zoning**—Areas of different color in a gem, caused by variations in growth conditions.

**Extinction**—Dark areas in a faceted transparent colored stone.

**Fine color**—The color or colors in a gemstone’s color range considered by the trade to be the most desirable.

**Hue**—The first impression of an object’s basic color.

**Intended color zoning**—Visible face-up color zoning that was planned during the cutting process.

**Planned light leakage**—Light that exits through a gem’s crown in a controlled way due to the correct proportions of its cut.

**Saturation**—A color’s strength or intensity.

**Tone**—Degree of darkness or lightness of a color.

**Trade terms**—Terms often used in the jewelry industry to describe particular gemstone colors or link gems with specific geographic locations.

**Unintended color zoning**—Visible face-up color zoning that the cutter was unable to conceal.

**Unplanned light leakage**—Light that exits through the pavilion in an uncontrolled way due to compromises in a gem’s proportions.

**Window**—An area of weak saturation in a transparent gemstone’s bodycolor that usually results from the way the gem was cut.
ASSIGNMENT 8

QUESTIONNAIRE

Each of the questions or incomplete statements below is followed by several possible answers. Choose the ONE that BEST answers the question or completes the statement. Then place the letter (A, B, C, or D) corresponding to your answer in the blank at the left of the question.

If you’re unsure about any question, go back, review the assignment, and find the correct answer. When you’ve answered all the questions, transfer your answers to the answer sheet.

________ 1. Which gemstone occurs in almost every color?
   A. Peridot
   B. Turquoise
   C. Tourmaline
   D. Lapis lazuli

________ 2. The first impression of an object’s basic color is its
   A. hue.
   B. tone.
   C. saturation.
   D. bodycolor.

________ 3. Generally, cool-colored hues with low saturation look
   A. bluish.
   B. grayish.
   C. brownish.
   D. yellowish.

________ 4. Use trade terms that imply geographic origin only if the
   A. color is typical of the source.
   B. gem’s actual source is known.
   C. clarity is typical of the source.
   D. color and clarity are typical of the source.

IF YOU NEED HELP: Contact your instructor through the GIA Virtual Campus, or call 800-421-7250 toll-free in the US and Canada, or 760-603-4000; after hours you can leave a message.
5. Which trade term describes certain tourmalines?
   A. “Paraiba”
   B. “Kashmir”
   C. “Sandawana”
   D. “Mozambique”

6. Which abbreviation does the GIA Colored Stone Grading System use for a slightly purplish red hue?
   A. pR
   B. spR
   C. slpR
   D. stpR

7. In practice, what GIA Colored Stone Grading tone levels apply to grading transparent colored stones?
   A. 1 through 11
   B. 2 through 6
   C. 2 through 8
   D. 2 through 10

8. A see-through area in a transparent gemstone’s bodycolor that usually results from the way the gem was cut is called
   A. extinction.
   B. a window.
   C. color zoning.
   D. color banding.

9. A window usually differs from the rest of the stone in
   A. hue.
   B. tone.
   C. saturation.
   D. hue and tone.

10. Extinction results from
    A. mixed cuts.
    B. deep pavilions.
    C. shallow proportions.
    D. excellent proportions.
11. The color of the background for grading a colored stone should be
   A. dark.
   B. bright.
   C. neutral.
   D. the same hue as the gem.

12. What type of lighting is best for grading color in a colored stone?
   A. Halogen
   B. Incandescent
   C. High red content
   D. Daylight-equivalent fluorescent

13. Higher levels of saturation are usually found in stones with
   A. dark to very dark tone.
   B. very light to light tone.
   C. very light to medium tone.
   D. medium to medium-dark tone.

14. What two coloring agents are usually responsible for color change in gemstones?
   A. Copper and iron
   B. Iron and titanium
   C. Cobalt and titanium
   D. Chromium and vanadium

15. Emission of visible light by a material when it’s exposed to invisible ultraviolet radiation is
   A. pleochroism.
   B. color zoning.
   C. fluorescence.
   D. color change.
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22. Topaz and Beryl
23. Tourmaline, Peridot, and Zircon
24. Garnet and Spinel
25. Lapis Lazuli, Turquoise, and Other Opaque Gems
26. Feldspar, Spodumene, and Diopside
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