Modern color measurement technologies go beyond the subjective human gaze and allow us to objectively quantify a rainbow of colors.
Image Source: Unsplash user Denise Chan

Color surrounds us every moment of our lives and affects our emotions, behaviors, and beliefs in large and small, **conscious and unconscious ways**. Color can set a mood, warn us of danger, give us critical information, and even bring us joy. Despite the universal presence of color, describing it remains elusive, in part due to **variations in color perception** from person to person and in part due to a lack of descriptors for each of the millions of shades seen by the human eye.

Instrumental color measurement moves beyond the limits of human perception and vocabulary and allows us to capture color information as objective data, creating **a common language of color** that is essential for communication within and between industries around the world. The two most advanced color measurement instrument types are colorimeters and spectrophotometers, both of which use sophisticated technologies to accurately and precisely quantify and define color. While closely related, these instruments have unique qualities that may make one more suitable than the other for a particular type of measurement.[1] Understanding the characteristics of a colorimeter vs. spectrophotometer can help you select the best tool for your application.

Colorimeters are ideally suited for evaluating final color results and identifying unwanted color variations.
Image Source: Pexels user Karolina Grabowska

Colorimeters

A colorimeter is designed to perform a type of **psychophysical sample analysis** by mimicking human eye-brain perception. In other words, it is designed to see color the way we do. By using a set illuminant and CIE 10 degree standard observer combination along with a tristimulus absorption filter that isolates a broad band of wavelengths, a colorimeter **distills color information into tristimulus values** to produce objective color data. If desired, this data may be compared to a standard or reference to determine acceptability.

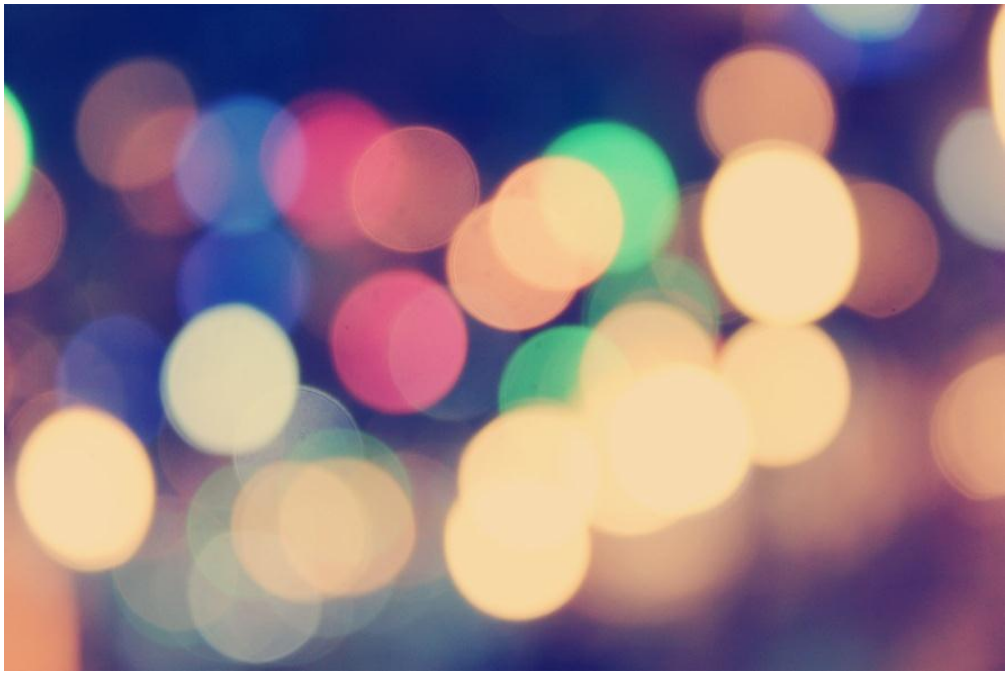
- **Applications**: Colorimeters are extraordinarily accurate for straightforward color measurement and ideally suited for determination of color difference, fastness, and strength as well as routine comparisons of similar colors. As such, they can be invaluable for color quality control and are primarily used in the production and inspection phases of manufacturing.
- **Disadvantages**: While colorimeters can produce highly accurate color measurements, they also have several shortcomings; they are **not able to identify metamerism** or colorant strength, are not ideally suited for color formulation, and cannot be used under variable illuminant/observer conditions.

Spectrophotometers

A spectrophotometer is an instrument designed for physical sample analysis via full spectrum color measurement. By providing wavelength-by-wavelength spectral analysis of a sample's reflectance, absorbance, or transmittance properties, it produces precise data beyond that observable by the human eye. If desired, spectrophotometers can be used to calculate psychophysical colorimetric information as well.

Applications: Spectrophotometers offer a higher level of flexibility and versatility than colorimeters due in part to the fact that they offer multiple illuminant/observer combinations and can operate in **multiple geometric arrangements**, including 45°/0° and d/8°. As such, spectrophotometers are capable of measuring metamerism, identifying colorant strength, analyzing a comprehensive range of sample types, and giving users a choice between including or excluding specular reflectance to **account for geometric attributes**. Full spectrum analysis also provides for greater specificity, potentially identifying color differences missed by colorimeters. Spectrophotometric instruments are ideally suited for a broad range of applications in the research and development phase, including color formulation and **color system development**, as well as color quality control throughout production.

Disadvantages: Although historically spectrophotometers have been significantly larger and more complex instruments that made them unattractive to some, today's technological advances have made it possible to manufacture smaller and more user-friendly spectrophotometers, eliminating many of those concerns. However, not all manufacturers require the capabilities of spectrophotometric instruments and may find that their needs are met by a colorimeter.



When considering a colorimeter vs. spectrophotometer, it's important to consider a variety of factors that may influence its applicability to your situation, such as illuminant source.
Image Source: Pexels user Sebastian Müller

Colorimeter vs. Spectrophotometer

Choosing a color measurement instrument requires an understanding of the advantages and disadvantages of both colorimeters and spectrophotometers as detailed above. If you are still uncertain about which instrument is best for your purposes, these questions, inspired by David R. Wyble of the Rochester Institute of Technology, can help you gain clarity when considering your options:[2]

- **Type of Data Required**: Does the application require spectral data or tristimulus values only?
- **Instrument Geometry**: Does the instrument have the geometry necessary for your application

- **Precision and Accuracy**: What level of precision and accuracy are necessary for satisfactory results?
- **Light Source**: Does the instrument have an appropriate light source for your application?
- **Rapidity of Measurement**: How quickly can data be obtained? What kind of sample preparation is required?
- **Ease of Use**: Is the instrument designed with the user in mind, facilitating simple and rapid operation?
- **Robustness**: Is the instrument appropriate for the environment in which it will be used? Can it withstand harsh factory conditions?
- **Software Interface**: Does the accompanying software allow you to easily collect, analyze, and share data?
- **Product Quality**: Not all color measurement instruments are created equal, regardless of whether they are colorimeters or spectrophotometers. By selecting the best quality instrument, you can be assured that you will obtain the highest quality results.

HunterLab Color Measurement

At HunterLab, we have been pioneers in the field of color measurement for over 60 years. We offer a comprehensive range of modern colorimetric and spectrophotometric instruments designed to meet the versatile needs and exacting standards of our customers across industries whether in the field, the lab, or on the factory floor. Our commitment to continuous innovation and technological excellence has led to the development of the highest quality colorimeters, spectrophotometers, and **software products** available on the market today, expanding the possibilities of color analysis, formulation, and quality control. **Contact us** to learn more about our color measurement instruments, customizable software packages, and dedicated customer support services and let us help you select the right tools for your applications.

1. "Difference Between Colorimeter and Spectrophotometer," March 6, 2012, http://www.differencebetween.com/difference-between-colorimeter-and-vs-spectrophotometer/
2. "Color Measurement – Introduction, Historical Perspective, Definitions and Terminology, Components of a Spectrophotometer, Light Source, Detector, Dispersing Element," http://encyclopedia.jrank.org/articles/pages/1246/Color-Measurement.html