Light and Lighting

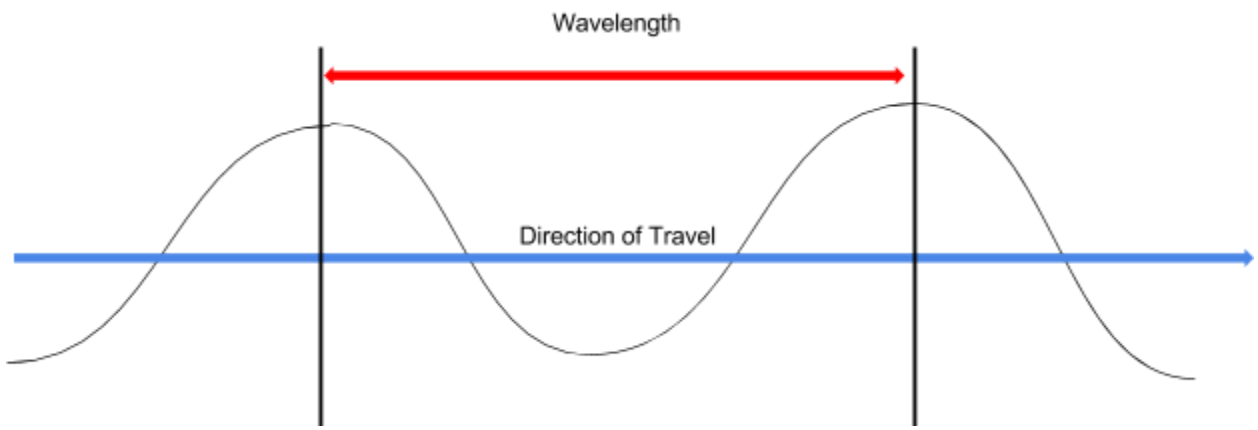
Describe the Theory of Light

Light is essential to both life and to the craft of the professional communicator. Photography quite literally means writing or drawing with light. Without light, there would be no photography or videography. The properties and characteristics of light have a direct impact on the product that an photographer is able to produce. As such, photographers are expected to be able to use light to their advantage in the course of their work. The techniques to do so will be covered in depth later in this guide.

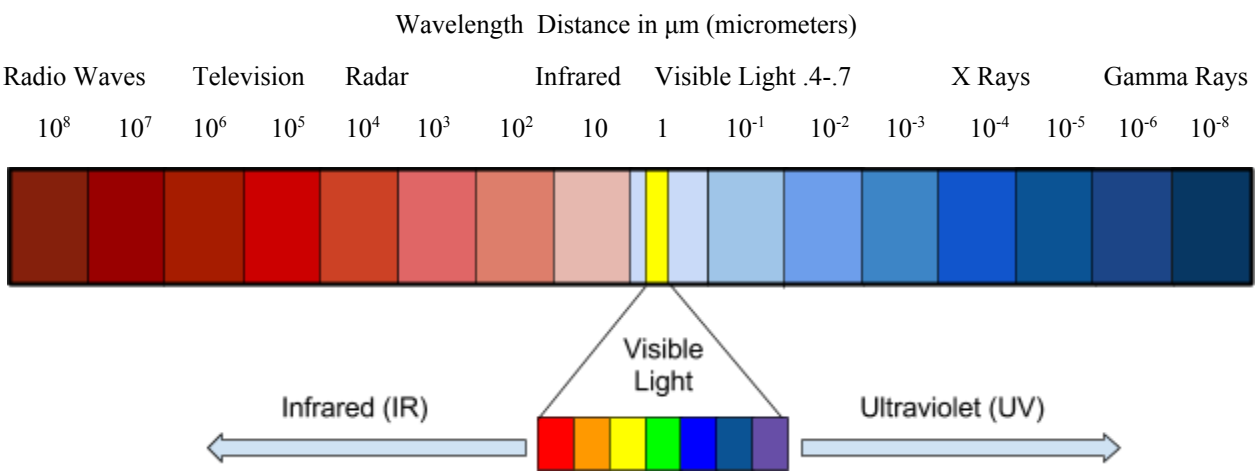
The building blocks of these techniques are an understanding of the Theory of Light. Though light is all around us, few photographers and videographers understand the nature of light and in that they are not alone. There is still debate in the scientific community about the nature of light. Simply put, light is a form of energy that radiates from a source. This source can be anything from the Sun to a simple lightbulb. Regardless of the source, light behaves both as separate energy particles and electromagnetic waves. (Zettl 19) Those electromagnetic waves make up the foundation of what is known as the electromagnetic spectrum, or in a more narrow sense, the spectrum of visible light.

Discuss the Electromagnetic Spectrum and Light Frequency

For the purposes of this discussion, let us disregard light particles and focus on the behavior of light as waves. Just like waves in water, electromagnetic waves have certain measurements to describe them. Wavelength is the distance from one peak to another in a wave of light.



Wavelength is measured in Nanometers or nm, which is one-thousandth of a millimeter. (Paine 3) It is important to note that though light travels in waves, it travels in a straight line radiating out from its source. The wavelength is the determining factor in where energy falls on the electromagnetic spectrum. For instance, the visible light spectrum is only between 400-700 nm. Energy at higher or lower wavelengths will present as infrared, gamma ray, x-ray, ultraviolet or microwave in accordance with the chart below:



The next measurement of light that concerns us is frequency. Frequency is the measurement of how many times a wave of light passes a given point in one second. Typically this measurement is expressed in the SI unit of hertz or Hz. 1 Hz is equal to 1 cycle per second, so for example a wheel rotating at 1 revolution per second, or 60 revolutions per minute (RPM) can also be described as having a frequency of 1 Hz.

Discuss the Following Light Behavior Principles

As light is radiated from a source, it is subject to certain principles in the way that it interacts with objects. A successful photographer or videographer knows and expects these interactions and is able to use them to their advantage. Keep in mind that the following principles are not just limited to light, they apply to all forms of energy on the electromagnetic spectrum. For the purposes of the following discussion, the term light has been chosen as it is the range of the electromagnetic spectrum that we are most likely to work with.

Before we begin describing the way that light behaves it is imperative to discuss the Law of Conservation of Energy as it has a direct bearing on the terms that follow. The law states:

In a closed system, energy is neither created nor destroyed, it is converted or transferred from one form to another

What this means for the photographer or videographer is that light is not created by your lighting instrument, it is merely converted from electrical energy to light. When you block light with a flag or modify it with a gel, it is not destroyed, just reflected or converted into thermal energy (heat).

Speed: The speed of light is variable depending on the properties of the surface that the light is passing through. For instance, the speed of light through air is 186,000 miles (299,000 kilometers) per second. (Paine 3) If light is passing through glass, for instance, it will slow down, and the wavelength will shorten but the frequency will remain the same. This is why we identify radiation and subsequently the color of light by its wavelength. Wavelength and the speed of light can be calculated using the following formulae:

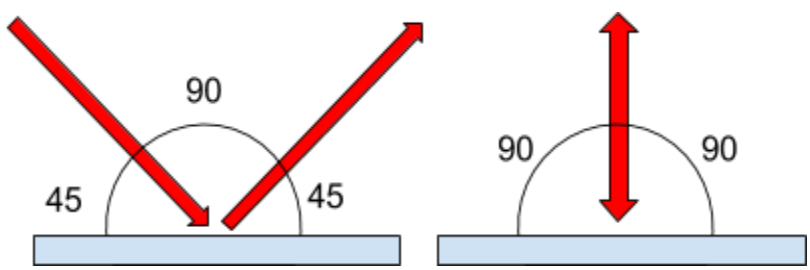
$$Speed = Wavelength \ X \ Frequency$$

or

$$Wavelength = Speed/Frequency$$

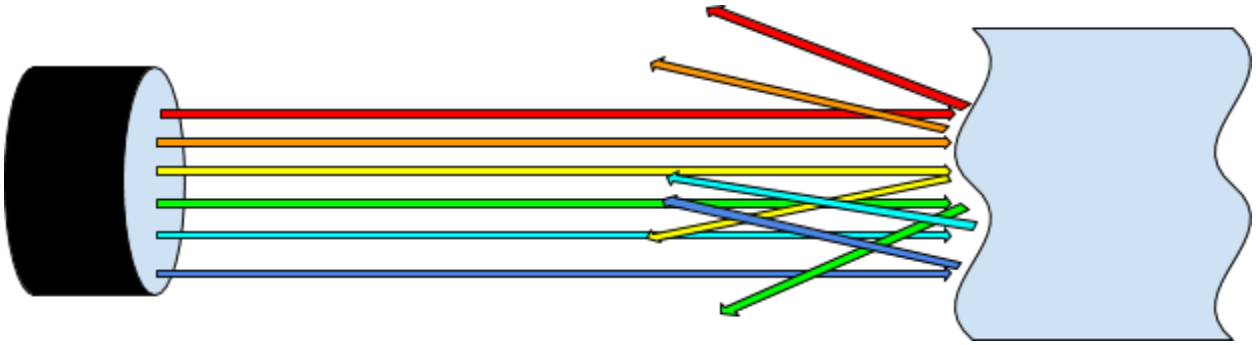
It is important to note two further things when it comes to the behavior of light. First, light will always travel in a straight line in a given medium (material) and secondly, the speed of light travelling through the same material will be constant. Light will speed up or slow down as it passes from material to material and as a rule will revert back to 186,000 miles per second when it is passing through air.

Reflection: Every time that light comes into contact with a surface, a variety of interactions may take place. The first of these interactions that we are going to discuss is reflection. Reflection of light occurs when light from a source bounces off of a surface. There are a few things to note regarding reflection. First, the reflected light will always reflect in the same angle as it reached the surface. So, if light strikes a surface at an angle of 45 degrees, it will be reflected back at 45 degrees. As shown in the first diagram below, when reflecting off of a flat surface, the sum of all of the angles will always add up to 180 degrees.



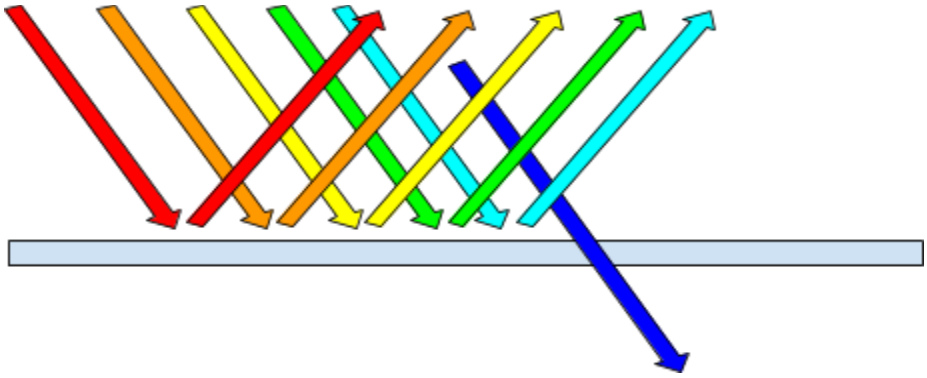
When the surface that the light is reflecting on is smooth, the resultant reflection will be orderly, or specular. Common examples of specular reflections would be mirrors or highly polished smooth metal. Specular reflections or highlights are easy to identify on photographs because they present as harsh often overexposed areas. Often the materials that light is reflecting off of is not smooth. Rough or textured surfaces diffuse or scatter light. This is a direct result of light from the light source reflecting at their complementary angles off of each of the imperfections in the

surface. This scattering of light creates a less harsh reflection, or a diffused reflection.



The less light that is reflected along the same axis as the eye or camera, the less harsh the reflection. This principle governing the behavior of light will become more important as we move into later topics.

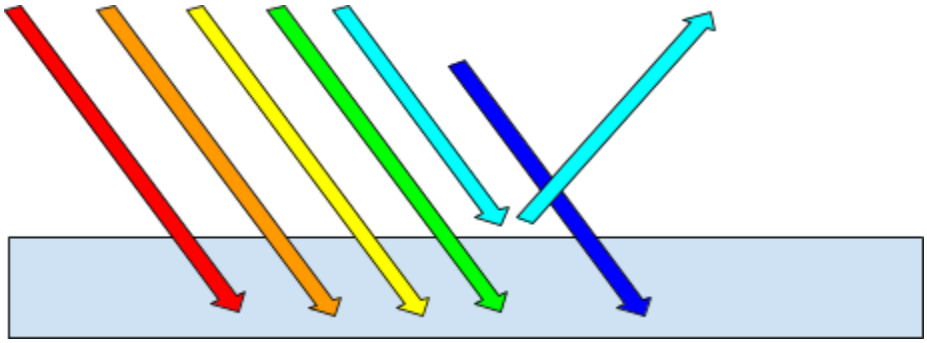
Transmission: Depending on the physical properties of the material that the light is hitting, not all of it may be reflected at a complementary angle to its source. Some of that light may pass through the object and emerge on the other side. Objects displaying these characteristics are said to be translucent, or clear depending on the wavelengths of light that they will allow to transit. There are many interactions that can take place within a medium that determines which light is transmitted, reflected or absorbed. These interactions also determine the properties of the light that may be transmitted.



In the example above, all light that is not dark blue is reflected from the surface, while dark blue light passes through the surface. The result of this example would be an object that appears blue to the eye while also changing white light into a dark blue light as it passes through, much like a

dark blue party gel. Multiple wavelengths of light can be reflected or transmitted through a surface depending on the properties of the surface.

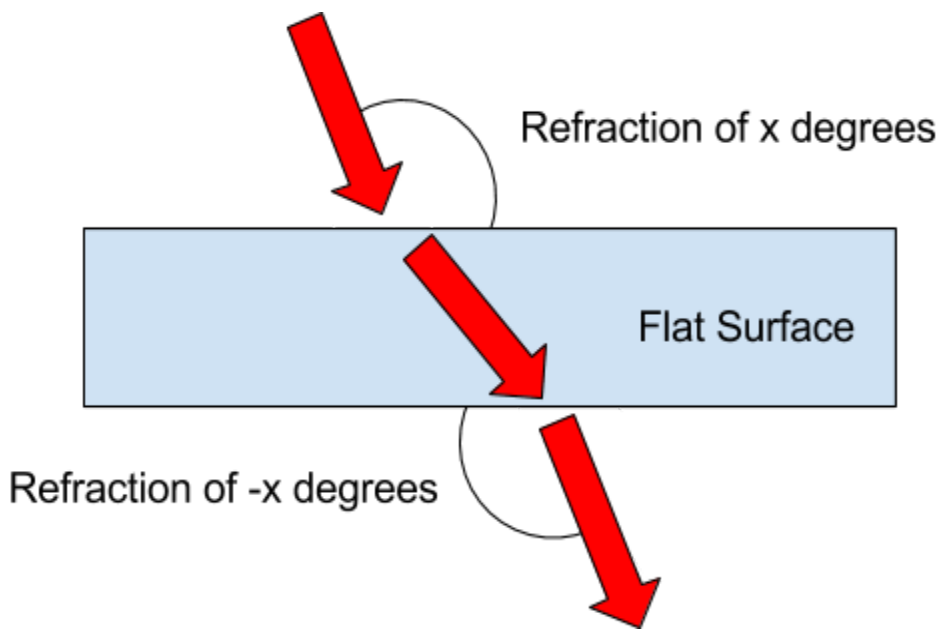
Absorption: In some cases, certain wavelengths of light are not transmitted, but either reflected or absorbed. Materials that are opaque fit into this category. The light that is reflected or absorbed by the opaque object will determine the color that the object appears to the naked eye, or to camera sensors for that matter. In the example below, all colors of light with the exception of light blue are absorbed by the material. Light blue is reflected from the surface resulting in an object that is light blue in color and opaque in nature.



As stated earlier, the color of the object is determined by the wavelengths of light that are absorbed, reflected, or transmitted. So, an opaque object that visually presents as black will absorb all wavelengths of light in the visible spectrum, allowing no absorption or transmission. Likewise, an opaque object that presents as white will reflect all wavelengths of visible light while allowing no transmission or absorption. Finally, an object that presents as clear will allow the transmission of all wavelengths of light with no absorption or reflection.

A final note on Absorption: Although light is interacting with a surface, it is still beholden to the Law of Conservation of Energy. If a material absorbs light energy, it has to convert that energy into another form in order to not violate the Law of Conservation of Energy. Most often this is accomplished by turning light energy into thermal energy, or heat. This is why black asphalt is hotter than white cement.

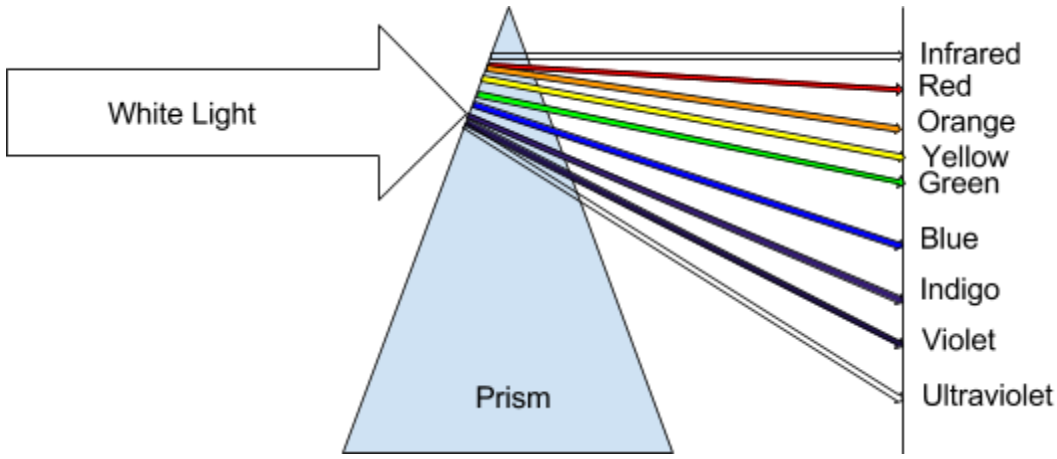
Refraction: As light is transmitted through a surface something interesting happens, its speed changes. As discussed in the Speed definition, the frequency of the light will remain constant as its speed changes, but its wavelength will change. Another side effect of this change in speed is that the light's direction will slightly change with each speed gradient. This direction change is referred to as refraction. If the both sides of the surface that the light is passing through are at the same angle, such as a flat pane of glass, the light will be refracted at the same angle that it entered the surface at.



The angle that light refracts as it transmits through a surface is directly related to the wavelength of the light. Remember, each wavelength of light represents a different color. As such, each color of light is refracted at a different angle. Light is only refracted when it hits a surface at an angle other than perpendicular to the surface. If light hits the surface perpendicular to that surface, it will pass through that surface, if it is not absorbed, at the same direction that it entered the surface.

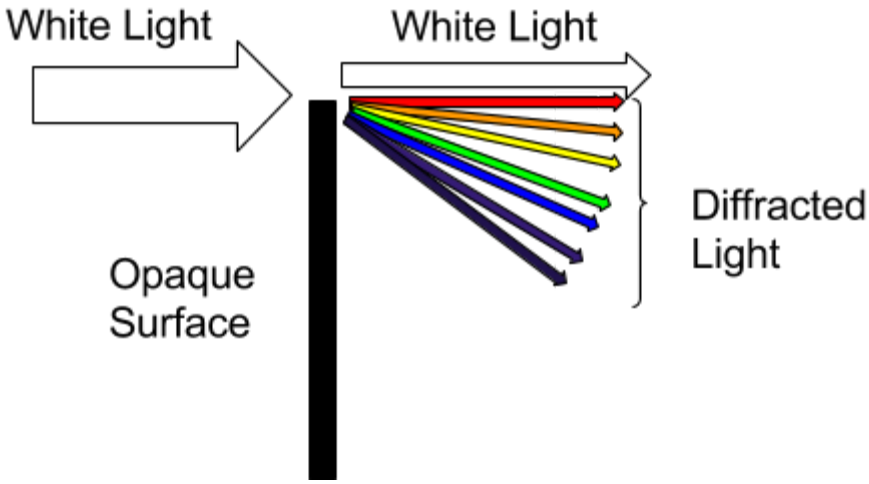
Dispersion: As mentioned in the previous section, different wavelengths of light refract at different angles depending on the material that they pass through. This separation of light is collectively known as dispersion. A very simple and common example of dispersion is white

light passing through a prism. As each wavelength of light enters the prism, they slow to different speeds and separate from one another, appearing as a rainbow that is emitted from the prism.

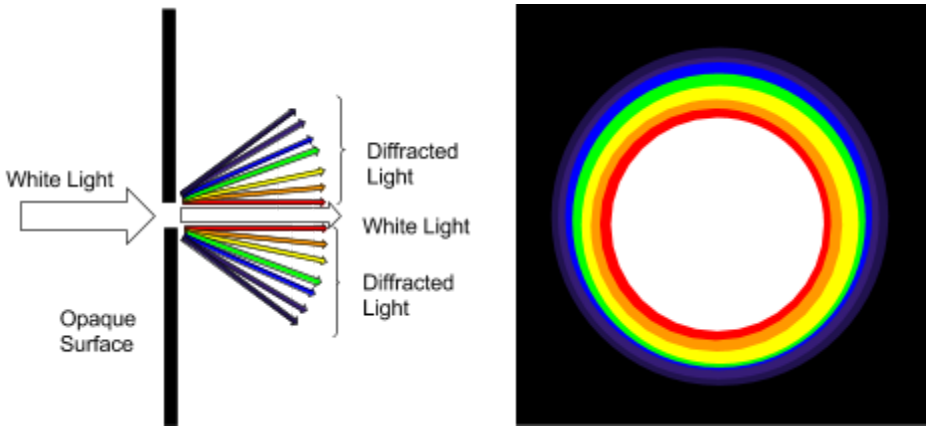


As demonstrated in the figure above, white light is broken into its constituent color wavelengths when passing through a prism. Note that Reflection, Refraction, Dispersion and Diffraction apply to all forms of energy along the electromagnetic spectrum. Just because you see the dispersion of white light into the visible color spectrum does not mean that there are not particles or wavelengths that you cannot see. i.e. Infrared or Ultraviolet.

Diffraction: Earlier it was stated that light always moves in a straight line. Diffraction is one instance where light does not follow that rule. When light is shined on an opaque edge, the light will bend slightly. As the light bends, it will separate into the wavelengths that make up the light.



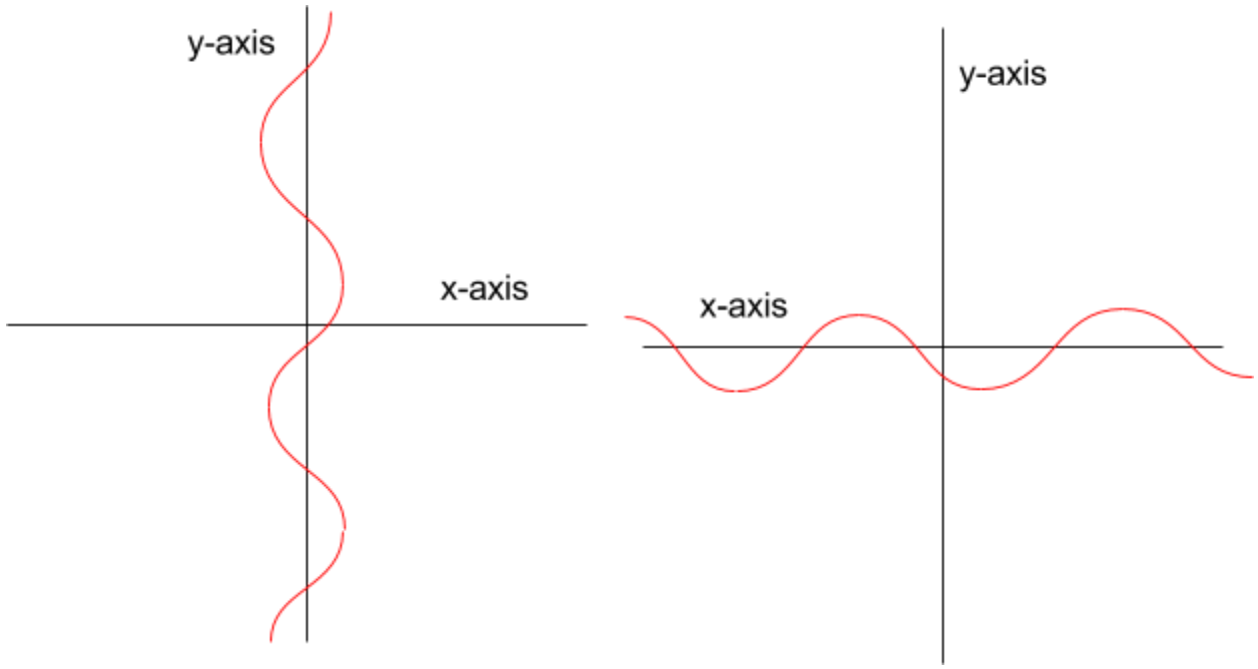
Another example of diffraction occurs when a light is shone through a small gap or hole in an opaque surface.



In the above example, light is diffracted through a small circular hole in an opaque surface. Light diffracts around all edges of the hole simultaneously resulting in a circular rainbow appearing around the fringes of the aperture. The effects of diffraction are increased as the size of the aperture decrease. The aperture of a camera operates in a similar fashion to the circular aperture described above, diffraction becomes more of an issue for a photographer as they decrease the aperture of their camera. The net result of this diffraction is a less sharp image when taken at an extremely small aperture than one taken at a moderate or wide open aperture.

Polarization: We have established that light particles (photons) move in a wavelike fashion. The motion of those waves is not constrained to just one axis of movement. For example, a wave moving on the X axis will appear to be moving left to right horizontally, while a wave moving on the Y axis will appear to be rising and falling. A two-dimensional representation of movement

on the X and Y planes would appear as a line with no depth oscillating horizontally or vertically.

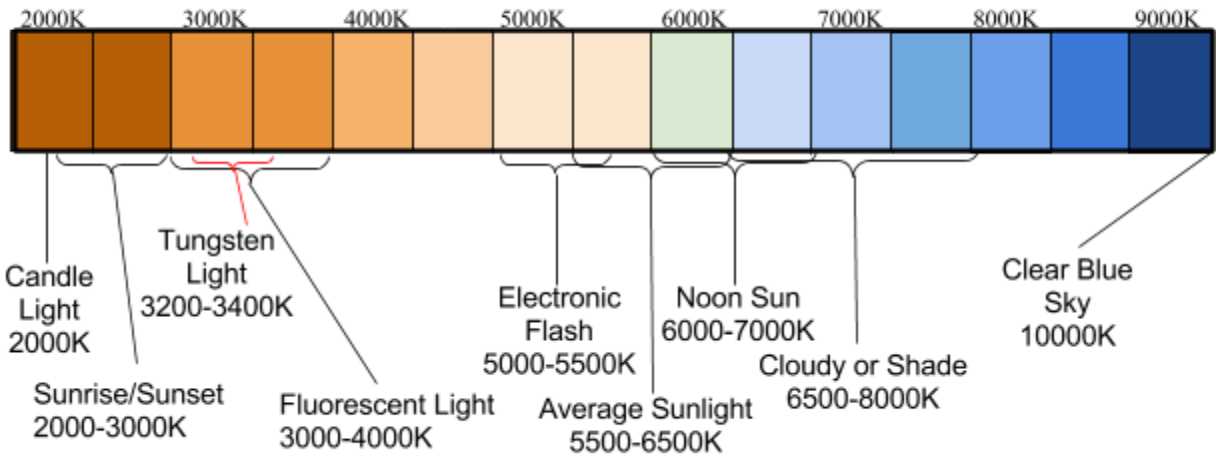


Wavelength movement is not restricted to movement on these two planes however. Waves may move On the X, Y and Z planes simultaneously. The resultant waveform of this type of movement would be a spiral, its diameter and circumference determined by the wave height. Polarization occurs when this light passes through a filter that restricts its movement to only one axis. For a photographer, polarization results in images that have significantly less glare. This can often mean that images taken with a polarizer filter can see through windows on a bright day, or through the surface of water without excess glare.

Define and Discuss Color Temperature

As discussed earlier, each color of light has its own unique wavelength. White light is made up of a combination of all colors simultaneously. Not every light source releases pure white light. An incandescent light bulb releases light that is more orange, while Light Emitting Diode (LED) lights typically release light that is more blue. We, as photographers and videographers, need a way to quantify the color of light that a source is radiating. From a practical perspective, we need a way to tell our cameras and video cameras what color is white.

Fortunately, scientists have given us a way to just that. The red/blue color of white light is described by a value known as Kelvin Temperature. This number is derived by looking at the natural color shifts that occur as you heat a black body. As it is heated, the black body shifts from black to red, then blue, and eventually white as more heat is applied. The Kelvin temperature that we use is a function of the heat that is applied to the black body. It is important to note that traditional color theory says that red colors are warm and blue derivatives are cool, when describing color Kelvin temperature, this is not the case. For Kelvin temperature, red colors have a lower value, while blue colors have a higher value.

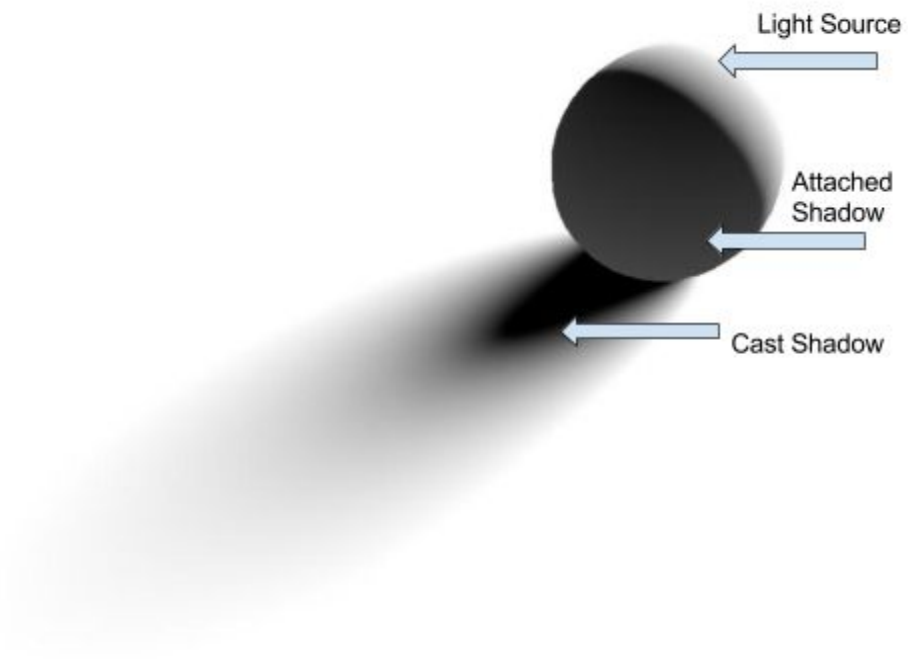


As a photographer or a videographer, we must know the color that each light source and how that impacts the image that you capture. Often times, you are going to encounter a situation where there are multiple light sources, each radiating at a different Kelvin temperature. This “mixed lighting” is a particular challenge and must be addressed by adding either orange or blue to the light sources to make them approximately the same Kelvin temperature. In order to effectively do this, the we must be able to identify the type of light and correctly place it on the scale above to determine what color, and at what strength to add to balance that light source against any others.

Define and Attached and Cast Shadows

We have spent a significant amount of time discussing light, its properties, colors etcetera… Light is only part of the equation when creating an image. The absence of light, or shadow, is what takes an image from being flat to containing volume. The contrast between light and shadow is instrumental in setting the mood or tone of an image.

Shadows can be defined as either attached or cast shadows. Attached shadows are always part of the actual object and will remain no matter how you move the object as long as the light source does not move. A good example of an attached shadow is a sphere where the side facing away from the light source remains in shadow. No matter how you move the object, there will be a shadow on the side that faces away from the light.



Cast shadows are created when light is blocked by an opaque surface and the shadow falls on a surface other than the object blocking the light. Cast shadows can be object connected, object disconnected or object independent. The image above is an example of an object connected shadow. Lifting the sphere off of the surface would detach the shadow from the object and create

an object disconnected shadow. In this scenario, the object casting the shadow is still within the field of view of the camera or camcorder. Removing the object casting the shadow from the field of view creates what is known as an object independent shadow (Zettl 22).

The position of the light in relation to the object being lit and the distance from that object to any other surface are going to be two of the important factors in determining the presence and quality of shadow.

Define and Discuss the Inverse Square Law

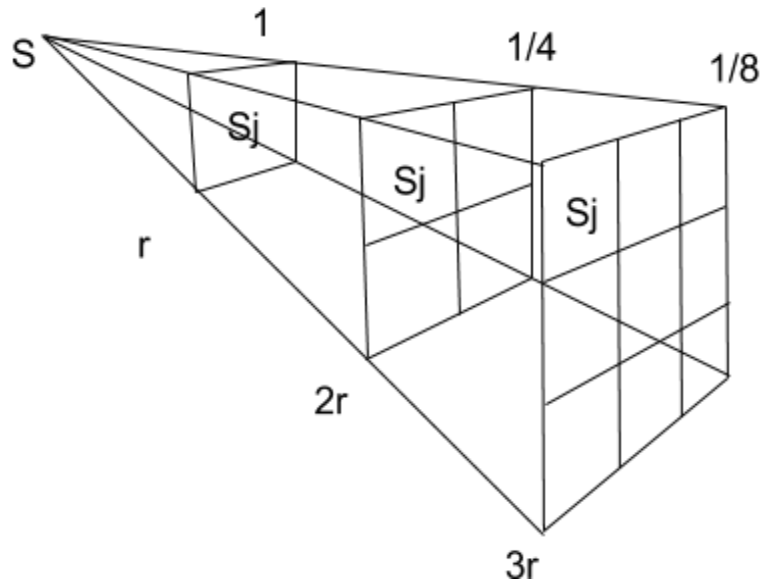
To this point, this discussion of the way that light interacts with objects after leaving its point of generation does not take into account the intensity of a light source. The presence or absence of light was sufficient for our earlier discussions, but now we will discuss the intensity of light and how that plays into our imagery.

Controlling the intensity of light that is emitted from a light source occurs in one of two ways. The first is by controlling the amount of power that is applied to the light. This method may not be the most practical because certain lighting instrument types, fluorescent lights for instance, cannot be dimmed. Other light sources, such as tungsten, experience radical shifts in color temperature as the power is either increased or decreased. These shifts often require the addition of gels to the light source to rebalance possible mixed lighting.

The most common way to control the intensity of light is to change the distance from the light source to the subject. You can experiment with this using a simple table lamp and a piece of paper. As you move the paper closer to the light, the light seems to reflect more brightly off of the paper. Likewise, as you move the paper further from the light source, the light reflects less light. The relationship between the distance between a light source and the intensity of the light it emits is described by The Inverse Square Law which states:

The intensity of illumination is inversely proportional to the square of the distance between the light and the subject.

In a practical sense, what does this mean for the photographer or videographer? Simply put, a light that is moved twice as far from the subject, only a quarter of the original light will be on the subject.



The diagram above shows that as the subject (Sj) moves away from the light source (s) the light diminishes by a factor of 2. As the subject moves from r to 2r, or twice the distance from the source, the light diminishes to ¼ of its original strength. At 3r the light is only ⅛ or its original strength. 4r would be 1/16 the amount of light, 5r would be 1/32 the amount of light and so on. The diagram above also describes what happens to light intensity as the subject moves closer to a light source. If the subject moves from 2r to r, or twice as close, the light is going to be 4 times more intense. Likewise, if the subject moves from 3r to 2r, the intensity change will be the same as moving from 2r to r. If the subject moves from 3r to r the light would be 8 times more intense than at 3r.

The placement of lights has a direct impact on both the intensity of the light and the results that can be achieved with that light. A photographer can obtain many different feels and lighting ratios by just moving the position of one light. For instance, a 1:1 lighting ratio would mean two lights of the same intensity placed equidistant from the subject. A much more dramatic 8:1 lighting ratio can be simply achieved by moving one light from r to 3r, or 3 times further away from the subject.

Define and Discuss Falloff

Both light and shadow have a tendency to fade in a gradual manner. This gradual change from light to shadow is known as falloff. There are two different, yet related relationships that we use this term to describe. First, the contrast in brightness between light and shadow. Secondly, the rate that the transition between light and shadow takes place. You can see this relationship at play all around.

When it comes to using falloff as a means to describe the contrast relationship between light and shadow, the term fast falloff means that the highlight area is very bright and the shadow is dark and rich (Zettl 25).. This is the type of falloff that is being played with in the ratio examples from the previous section. A lighting ration of 8:1 would lead to a dramatic contrast in highlight and shadow meaning a fast falloff. Likewise, a lighting ratio of 2:1 would mean far less contrast between highlight and shadow and therefore a slow falloff. A lighting ration of 1:1 would eliminate falloff because both the main and fill lights would be striking the subject at the same intensity. This is also known as flat lighting due to the absence of shadows that give the subject depth.

In its second usage, falloff describes the rate of change between light and shadow on a subject. Sharp and dramatic changes in contrast, such as the shadows from a sharp corner are exhibiting fast falloff. There is very little gradient, if any at all, in shadow when describing fast falloff.

Conversely, when shadows stretch around curved surfaces, the transition between light and dark is much more gradual. This gradual change is slow falloff in action. In this case, the slow falloff serves to give a sense of shape and volume to a curved surface.

Define and Discuss the Concept of Outer Orientation

The use and presence of light in a scene tells us a lot of information about that scene and how it relates to the world around us. Light can tell us the shape of an object, its texture, and its position in time (Zettl 26-30). Collectively, these are called outer orientation.

Not only can light tell us the overall shape of an object, it can tell us its position in space. That is one of the main functions of the Key or Main light (Zettl 26). The object's attached shadow gives the basics of the shape of the object whereas the cast shadows give a sense of place to the object in space. The way that a light source interacts with the different textural elements of a surface provide a lot of information about the composition of the surface. All of this information serves to provide contextual clues about the identity of the object and its position in space. Finally, we can infer a lot about the scene's place in time based upon the direction that the light is hitting an object within a scene.

Unknowingly, we can make many judgements about the time that a scene takes place based upon our experiences in the natural word. Simply put, day is bright and night is dark. The absence of shadows and harsh top lighting may indicate that a scene was photographed near midday. At midday, the sun is at its apex and thus does not produce much shadow. Earlier or later in the day, the sun is at increasingly extreme angles resulting in long shadows. We can use the length of shadows, much like a sundial, to have a clue about when a scene was shot. Also, we can use color temperature and light intensity to seasonally place a scene. Outdoor light in winter is typically less intense and trends towards a slightly higher Kelvin temperature than the warm summer sun.

Define and Discuss the Concept of Inner Orientation

While light tells us a lot about the physical structure of a scene, it does something else. Light and shadow convey a sense of mood and atmosphere. This internal feeling is referred to as Inner Orientation. Something as simple as the amount of light that is present in a scene can create a broad range of emotions in the viewers. For instance, High-Key lighting, where the scene is illuminated in a way to reduce contrast, exudes a feeling of hope or airiness.

High-Key lighting

Photo by Camilla Rose Henley

Low-Key lighting

Photo by Gürkan Sengün

On the other hand, Low-Key lighting places emphasis on high contrast and a low level of background light. The highlights are directional and very specifically placed. Low-Key lighting is typically used to light spaces where there is little expectation of light, such as caves, submarines and night (Zettl 30). Whereas High-Key lighting is light and hopeful, Low-Key lighting leads to a feeling of drama and foreboding.

While the amount of light can go a long way in setting the overall mood of a scene, the position of the light source in relation to the subject also contributes to the inner orientation of a scene. Remember the cliche campfire trick of holding a flashlight below your chin to make you look foreboding when telling a scary story? This is an excellent example of using the position of the

main light source in a Low-Key lit environment to change the audience's inner orientation from normalcy to tense drama.

When a subject that is lit from above their eye-level, the shadows on their face fall in a way that we as viewers are used to and the scene is interpreted as normal.(Zettl 31). Moving the main light below the eye level of the subject inverts the way that the shadows fall on the face creating a subject that is dark, foreboding and possibly scary. Just like the person telling the scary story around the campfire.

Light can also be used to heighten the drama or intensity of a scene by moving around or showing the light source itself. In a video, the scene may move from High-Key to Low-Key lighting when moving from one location to another. This may also be used as a trick to change the feel or the mood of the moment from one of hope to an ominous moment. Likewise, the position of the main light may move depending on the mood that is intended. Having a light move from above eye level to below eye level may portend that the subject is undergoing a change from good to evil for instance. Showing the light source that is illuminating the subject may also serve to set the scene. For example, in a scene where the subject is standing next to a road at night would make sense to have the subject lit by the headlamps of an oncoming car. Showing the lights that are used to illuminate the subject also serves to set the scene.

Define and Discuss Triangle (3 Point) Lighting

To this point, we have spent a significant amount of time describing theory. Now it is time to discuss how we, as photographers and videographers, can put this theoretical knowledge into practical use. Triangle or 3 Point lighting is the most common lighting setup that photographers and videographers use in both studio photography and videography. To understand how this lighting works, it is first important to understand the components of this setup. First, as the name implies, there are three lights that are used to accomplish 3 Point Lighting. They are:

Main Light: As its name would imply, the Main Light is the primary source of illumination for your subject. This light is what is going to determine the overall exposure level and the intensity of the other lights in the scene. The Main Light may be positioned on either side of the subject and may illuminate the side of the face turned towards or away from the camera, broadside and short side lighting respectively (London 391).

Fill Light: The Fill Light works in conjunction with the Main Light to soften, or fill in, the shadows created by the Main Light. These shadows define the depth of the subject and the intensity, or darkness, of these shadows is controlled by the intensity of the Fill Light. The Fill Light is the light that is going to determine the lighting ratio 1:1, 2:1 4:1 etc… of a scene. Traditionally, the Fill Light is placed opposite the Main Light and strikes the subject at approximately the same angle as the Main Light.

Backlight/Hair Light: Now that the tront of the subject is illuminated, it is time to pay attention to how the subject interacts with the background of the scene. The Backlight or Hair Light provides a sense of separation between the subject and the background. Essentially, a Backlight creates a small rim of light on the fill side of the subject to prevent the subject from disappearing into the background.

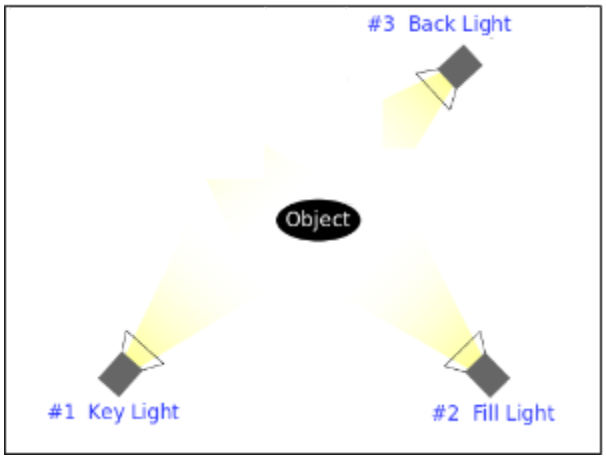


Photo by James Jeffery

The diagram above shows a basic 3 point lighting setup as well as the results that such a setup would yield. This lighting setup does a good job of lighting a subject independent of their background. Sometimes, however, it is necessary to show what is directly behind the subject. In this case, standard 3 Point Lighting becomes 4 Point Lighting by the addition of a background light.

3 Point Lighting is often the first form of lighting that is taught because it will typically deliver a useable product in a wide variety of situations. Keep in mind, 3 Point Lighting is a basic form of lighting. It suitable for delivering a well lit interview or studio portrait, but may not deliver the desired aesthetic if a more dramatic or emotional look are desired.

Define and Discuss Chiaroscuro Lighting

Often times the photographer or videographer will want to use the contrast between light and dark to add drama or emotion to their imagery. They may also want to show or clarify the volume of the image to make it appear more three dimensional in nature. This is the role of Chiaroscuro (kee-aura-skoor-o) lighting. This lighting can be quickly identified in photographs and videos by looking at the relationship between highlights and shadows. Chiaroscuro lighting features highly directional lighting that highlights certain intentional aspects of the scene coupled with fast falloff shadows.

The Matchmaker Gerard van Honthorst (1590–1656)

The painting above illustrates key aspects of Chiaroscuro lighting. The light emanating from the candle on the table illuminates the subject of the painting while the falloff from that light provides definition to the other characters around the table. Honthorst clearly wants to draw the viewer's attention to the face and front of the subject while allowing other supplementary details to be lost in shadow.

In a more academic sense, lighting should still perform at least some of these aesthetic functions: organic, directional, spatial or compositional, thematic or emotional (Zettl 40).

Organic: Light that is added to a scene should look as though it has a purpose for being there. Take the Honthorst painting above for instance, it would seem out of place for the artist to illuminate the scene from above when there is clearly a burning candle on the table. The same holds true when photographers and videographers light scenes. If a subject is sitting near a window during daytime, illuminate them on the side that the window is on.

Directional: Light can be used to highlight portions of the image that the photographer or videographer wish to highlight. This is used to take the viewer on a visual journey through the image and detail important items. In the painting above, the

Spatial: Light areas and dark areas of a frame should be spaced out in such a way as to allow for a sense of balance to be present within the scene. Images that are too skewed light or dark may not have visual interest, or worse may distract from the message that the shooter is intending to convey.

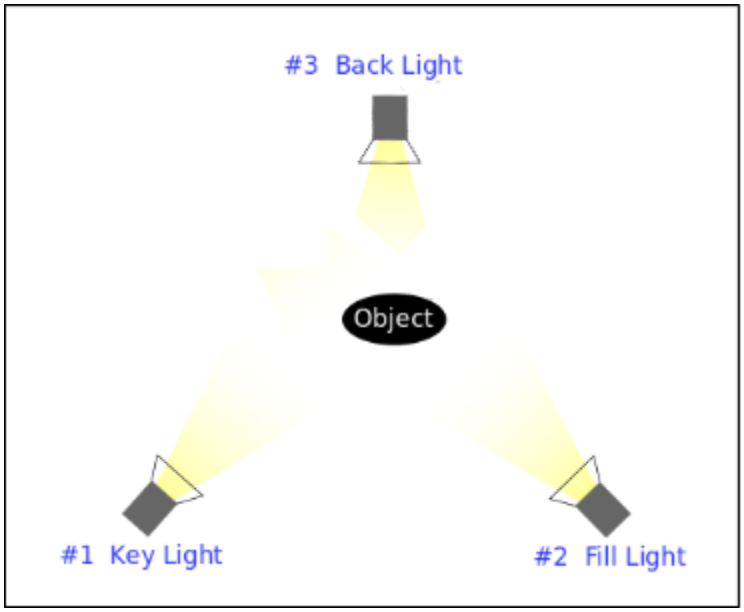
Thematic: The way that a scene is lit should serve to help in telling the story that the photographer or videographer wishes to tell. If the overarching theme of the piece is death for instance, the photographer should emphasise the shadows of the scene. Likewise, if the scene is about birth or life, High-Key lighting may be in order.

Emotional: Emotional and Thematic functions are closely tied with one another. The emotional function of light is to impact our feelings regardless of subject matter (Zettl 42).

Define and Discuss Flat Lighting

Flat Lighting is the exact opposite of Chiaroscuro Lighting. Instead of creating dramatic interplays between highlight and shadow, the function of Flat Lighting is to eliminate shadow. Typically, Flat Lighting does not have an obvious light source. Light wraps around the subject casting translucent and almost invisible attached and cast shadows. In short, nothing is lost in shadow because shadows are not present in the scene.

Achieving flat lighting in a scene is a simple matter of first placing Main and Fill lights equidistant from the subject. They should be facing the subject at approximately the same angle. Secondly, Flat Lighting is achieved by broadly diffusing the light to further eliminate shadows.



President Barack Obama's transition portrait is a good example of flat lighting. His face is evenly illuminated with a very slight falloff of light between his nose and ears. In this instance, much like the studio portraits that we take on a daily basis, there is a light placed to illuminate the flag and the background.

Define and Discuss Silhouette Lighting

Unlike the lighting techniques that we have discussed to this point Silhouette Lighting emphasises contour over volume or texture (Zettl 46). Silhouette Lighting has elements of both Chiaroscuro and Flat Lighting, but it is different enough to be considered a separate type of lighting. Like Chiaroscuro Lighting, Silhouette Lighting exhibits extreme contrast between highlight and shadow, but it also Flat because of its emphasis on contour. Silhouettes can easily be identified by their light background with a subject represented by dark shadow.

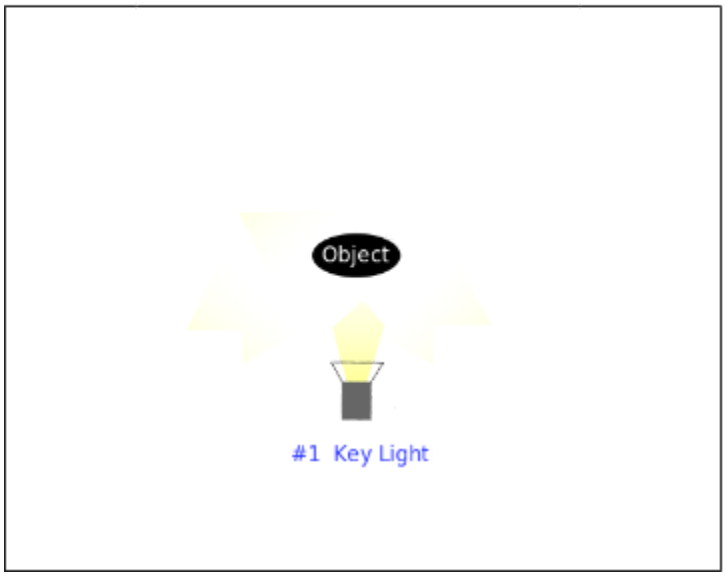
The key to effective Silhouette lighting is lighting and exposing for the background of the image. The subject that will be the silhouette is placed between the light source (background) and the camera. The photographer then exposes for the extremely bright background thus rendering the darker subject as a complete shadow (the light is hitting the side of the subject away from the camera).

While the photograph above is an effective silhouette, it also demonstrates that a silhouette is not a studio-exclusive phenomenon. They can occur whenever and wherever a bright light source is behind the subject. As stated earlier, to achieve the silhouette, the photographer must expose for the light source and not the subject.

Define and Discuss Front Lighting

As its name would imply, front lighting is illuminating a subject by a single light placed directly in front of the subject. The light source is placed as close to the axis of the lens as possible to

reduce the distance that shadows extend from the object that cast it. This lighting is traditionally very flat in nature because the subject is looking directly into the light thus light is cast on both sides of their face evenly. It also serves to minimize texture because no light is hitting the subject from the side. Falloff from light to shadow will depend on the size of the light source and the extent that it is diffused.



Unless the photographer uses an lighting implement such as a ring flash, the camera and the light source will be off axis from one another slightly. Photographers need to be conscious of the possibility of red-eye when using a flash light source that is on axis with the lens of the camera.

Define and Discuss Side Lighting

Moving the Main light from directly in front of the subject to the side of the subject can affect a large change in the mood of the resulting image. Side Lighting serves to emphasise facial features and textures, such as that of skin (London 240). Typically the light is placed at subject level and directly to the side of the subject. The light may be hard or soft depending on the intensity and falloff speed of shadows desired. If a subject is facing the camera, side lighting will appear as though the subject has a line demarking light from shadow down the center of their face.

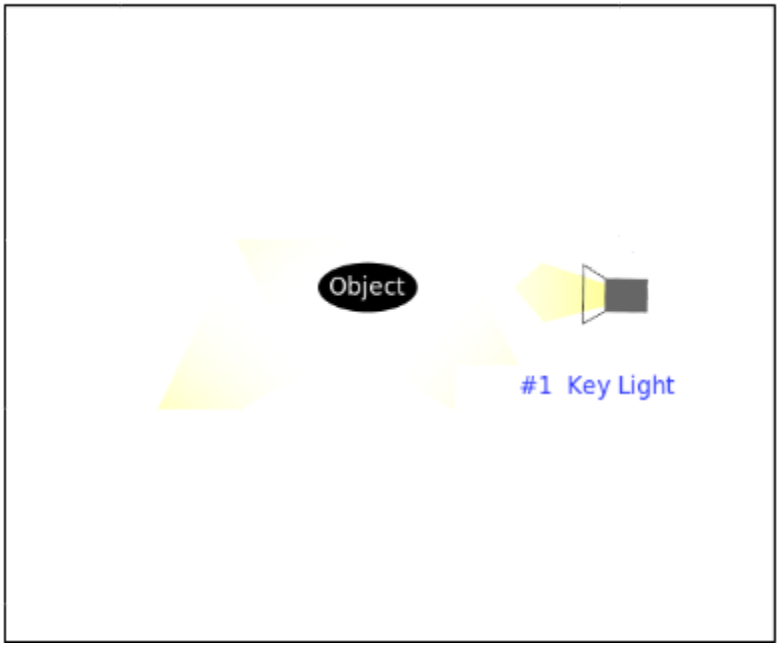


Photo by Hari Bhagirath

The above self portrait by Hari Bhagirath also illustrates a common scenario in which side lighting is used, the window portrait. Sitting a subject next to a window makes for a quick side lit portrait setup with no lighting equipment required. Light shining through the glass of a window will be softer than undiffused daylight. A portrait such as this can play with the internal orientation of the image and make it read more dramatic.

Another quick and effective use of side lighting for portraiture is the High Side Light. This modification of Side Lighting takes the Main Light and moves it 45 degrees from the side of the subject and 45 degrees down on the subject. The resulting photo mimics the lighting that we see in natural daylight and does a great job at rendering the face in three dimensions as well as being flattering for the subject (London 230).

Define and Discuss Backlighting

The initial setup for a Backlit shot is essentially the same as for a silhouette the exception being that the light produces a rim or halo or light around the subject. As there is no light shining on

the face of the subject, the face will fall off into shadow as will the background. Special care must be taken to ensure that the light and its stand are not visible in the image. Using a Backlight on its own is a specialty portrait that we will rarely use. Backlighting is often used in other lighting styles to separate a subject from a background.

Define and Discuss Existing Light

Every one of the lighting styles mentioned above can be achieved using a variety of lighting instruments. While we focused on each of these lighting techniques in a studio environment, each can be accomplished using nothing but the light that exists in the scene. Photographers and videographers cannot overlook the brightest light on Earth when making their images, the Sun. By moving your subject in relation to the position of the Sun, you can move from one lighting technique to another. The time of the day, the time of the year, clouds and the presence or absence of trees are all things that can affect the quantity and quality of existing light.

Even sunlight can be modified to fit the needs of the photographer. Silks can diffuse sunlight resulting in a nice highly diffused light. Reflectors and bounce cards can reflect light from the sun and take the place of the Fill Light to enable multi-point lighting when outdoors. In short, the type of lighting that can be achieved is only limited by the photographer's imagination and their tools on hand.

Existing light is not limited to light created by the Sun. Anything that creates a light in a scene that is there naturally is existing light. For instance, a candle, a fireplace, light streaming through a window are all sources of existing light.

Define and Fluorescent Lighting

Through the course of our job, one of the most common lighting scenarios that we will encounter on a day-to-day basis is lighting for fluorescent lights, i.e. in an office space. Fluorescent lights are gas lamps that contain mercury vapors that create light when electricity is passed through

them (Lynch-Johnt 43). The light that is emitted by these lamps typically has a green hue that can be difficult to balance when using other light sources. There are multiple solutions to dealing with the green cast by fluorescent lights. If possible, i.e. when lighting by other means, turn off the fluorescent light source. If that is not possible and the fluorescent light source is the only available light, most cameras have a built in white balance setting to correct the green cast. If you are in a mixed-lighting scenario involving fluorescent lighting, a magenta filter for the camera, or green gels can be used on external strobes to white balance the image.

Recent years have seen a shift from traditional fluorescent bulbs to daylight balanced bulbs. These lights are balanced to emit light at approximately 5400K. If these bulbs are present, the scene can be shot as though in outdoor sunlight. A good rule of thumb when shooting indoors is to look at the lights that are present, take a test shot and white balance from there. In tricky lighting situations, such as a mixture of daylight balanced and traditional fluorescent bulbs, setting manual white balance on your camera with the aid of a white card may yield the best white balance and consequent color rendition.

Discuss the Following Factors that Affect Exposure when Using Flash

Managing exposure when illuminating a scene with flash strobes, either studio or portable units, changes the way in which a photographer must control their exposure. Each of the traditional exposure controls, shutter speed, aperture and sensitivity (ISO) has a significant impact on how the light from a flash is rendered in the subsequent image. For most images, the end goal of using flash is to make it a inconspicuous as possible. Flash should compliment the scene, not dominate it. The key to achieving this goal is mastering how exposure controls affect the light from the flash.

Shutter Speed: Traditionally, shutter speed is a method for controlling the amount of motion that is present in an image. Slower shutter speeds leads to more motion blur in an image. Flash however, tends to freeze the action at the moment that the strobe was triggered. Shutter speed

does have an important role to play though. It controls the amount of background light that is present in the image. High shutter speeds will result in little, if any, ambient light. Slow shutter speeds allows more of the natural light in the scene to bleed through into the image. This delicate balance between flash power and ambient light is what allows the photographer to blend flash into their final image

Aperture: If shutter speed controls the amount of background light in an image, aperture controls the amount of flash that is in an image. The larger the aperture, the more light from the flash is allowed to hit the sensor.

Sensitivity: The sensitivity of the sensor (ISO) will raise or lower the effects of both shutter speed and aperture simultaneously. Just like adjusting ISO without flash, adjusting this value has the potential for introducing unwanted grain into the image.

Distance: Flash, just like any other light source is beholden to the Inverse Square Law. As discussed earlier, moving the light source either towards or away from the subject will result in an increase or decrease of light by a factor of 2. For example, moving a flash twice as far from a subject will result in only ¼ of the original light striking the subject. Moving that same light back the same distance again will result in ⅛ of the total light striking the subject. That same formula holds true when moving the light closer to the subject. In short, changing the distance between the flash and the subject changes the intensity of the flash on the subject.

Flash Compensation: Every light modifier that is applied to a flash will impact the amount of light that eventually reaches the subject. You may hear some photographers talk about how using a diffuser costs them x-stops of light. Flash compensation is a quick way to account for this.Most modern flashes will allow the photographer to quickly adjust +/- 3 stops from the flash unit itself. This allows the photographer to not worry about adjusting the aperture (affecting the image depth of field) to increase the power of the flash. This is also extremely helpful for making flash power adjustments when in flash modes other than manual.

Discuss Flash Synchronization Speed

Earlier, when discussing the theory and properties of light, we discussed the speed of light. In terms of flash photography, light travels from the flash to the subject and from the subject to the sensor of the camera nearly instantaneously. Unfortunately, the shutter mechanisms of modern cameras are nowhere near that fast. The focal plane shutters in DSLR cameras operate by having two black curtains that pass over the sensor to expose the sensor to light coming in through the lens. These curtains move at slightly different times producing a gap across the sensor as they move. The time delay, and thus the size of the gap is what determines the "shutter speed" of the camera. For example, a shutter speed of ½ of a second would result in a gap being big enough to be easily seen by the naked eye. Conversely, a shutter speed of 1/8000 of a second would only present as an extremely small slit that passes over the sensor.

When taking a photo using flash, if the shutter speed is set to higher than 1/200 of a second for Canon cameras and 1/250 of a second for Nikon cameras the light from the flash will enter the lens and strike the shutter instead of the sensor. When this happens you will notice a thick black horizontal band on your image obscuring part, or most of your image depending on the shutter speed of the camera.

Modern DSLR cameras and flash units have electronic controls that minimize the chance that this will happen. This is known as the synchronization or sync speed. When a flash unit is attached to the camera and turned on, the camera will limit the maximum shutter speed to avoid the shutter being present in the image.

There are some times when a photographer may want to use flash at a shutter speed higher than 1/200 second for Canon and 1/250 second for Nikon. If this the case, most modern on-camera

flash units have a setting called high speed sync. With this setting enabled, the flash will emit a series of pulses to illuminate the entire frame of an image up to 1/8000 of a second.

Discuss the Following Flash Modes

TTL: TTL or Through the Lens is an automatic flash control that uses the light passing through the lens of the camera to turn off the flash when the camera records a correct exposure (Lynch-Johnt 122). As a rule, TTL flash modes will only work with direct flash and only with the flash head locked in the down position.

Automatic: Automatic flash is a setting where the camera measures the light that is falling on the scene and automatically fires the flash in low light scenarios (Lynch-Johnt 11).

Manual: As its name implies, Manual flash is a mode where the photographer takes complete control over the the flash unit. This mode allows the most aesthetic control but requires the photographer to know how to manipulate the camera's exposure controls.

Slow Sync: As discussed earlier, shutter speed controls the amount of ambient light in a scene. Sometimes photographers want to emphasize motion while using flash. Slow sync flash couples slow shutter speed to emphasise motion while using flash to freeze action and retain detail.

As the image above demonstrates, the result of slow sync flash will be items frozen in place with trails and streaks denoting their motion.

Rear Curtain: The focal plane shutters of modern DSLR cameras operate with two curtains that pass over the sensor to expose the sensor to light. When using a flash, the photographer has an

option of when during the exposure to trigger the flash. This is known as either front curtain sync or rear curtain sync. Front curtain sync means that the flash is fired as the first curtain reveals the sensor. The result of this is light trails that in front of the subject frozen by the flash. In most instances, this can be a jarring visual effect. Rear curtain sync fires the flash just before the second curtain covers up the sensor ending the exposure. The resultant image has motion trails that extend behind the subject. This typically appears more natural and less jarring than front curtain sync.

Fill Flash: Fill flash is the use of artificial light to supplement ambient light and add light to shadows when subjects are backlit, in shadow or illuminated by high-contrast lighting (Lynch-Johnt 40). In extreme cases, fill flash can be used to match the apparent intensity of the sun in a backlit scene thus rendering a natural looking exposure. This technique used to be referred to as synchro-sun flash.

Red Eye Reduction: When a flash is attached to a camera and is positioned close to the axis of the lens, the resultant image may exhibit what is known as red eye. This is as a result of light from the flash bouncing off of the subject's retina and back into the camera. The simplest solution for reducing or eliminating red eye is to remove the flash from the axis of the lens. Some cameras and flash units have a built-in red eye reduction feature which shines a brief burst of light at the subject before the image is exposed. This serves to contract the subject's pupils and reduce the window that light has to enter the eye and cause red eye.

Discuss the Following Flash Techniques

Flash units are a portable light source and are capable of far more than emitting a simple one location harsh light. A single flash unit is capable of mimicking most light sources that a photographer can find in nature. Learning both how to use the flash unit and modify the light that it creates can take an ordinary photograph and make it stand out, tell a story or evoke an emotional response.

Off Camera: Moving the flash from its hot shoe is one of the easiest things that a photographer can do to drastically change the resultant image. If the flash is left attached to the camera, the photographer is mostly limited to shooting their subject frontlit. Moving the flash unit allows a photographer to go from a frontlit portrait to sidelit, high-side lit, or even a back lit portrait. some of the most famous portraits were lit using only a single light source. Very few were taken with a flash attached to the photographer's camera.

There are multiple ways to get the flash to function apart from the camera. The most common ways that a modern photographer will have experience is by using either a sync cable, or on newer camera systems a wireless sync system. Wireless sync systems may be controlled by a variety of means such as radio frequency (RF), Photonic (triggered by light) or infrared (IR). The type of wireless syncing that you can use will depend greatly on the capabilities of your gear and the distance that you need the flash to work from the camera.

Off Camera Using Multiple Synchronization: Modern camera systems have the ability to control multiple portable flash units simultaneously. This gives the photographer the ability to establish main, fill, hair and background lights if they so choose. Essentially, a photographer can have an entire studio light setup that can fit into their camera bag. Additionally, current flash offerings have the ability to be divided into multiple shooting groups allowing photographers to control in excess of 100 portable flash units at a time. Flashes can be grouped together and fired simultaneously so that they can mimic much larger studio strobes. Finally, modern flash systems allow the photographer to change the settings on each group of flashes from the master unit attached to the camera, thus giving the photographer quick and easy control over their flash units.

Bounce: In section 102.4.3 we discussed how light can reflect off of a surface. Essentially a photographer can use this reflectance to their advantage when using a light source. Light is emitted from a flash unit, hits a surface and is then directed onto the subject. This allows

photographers to drastically change the direction that their light hits their subject with minimal effort.

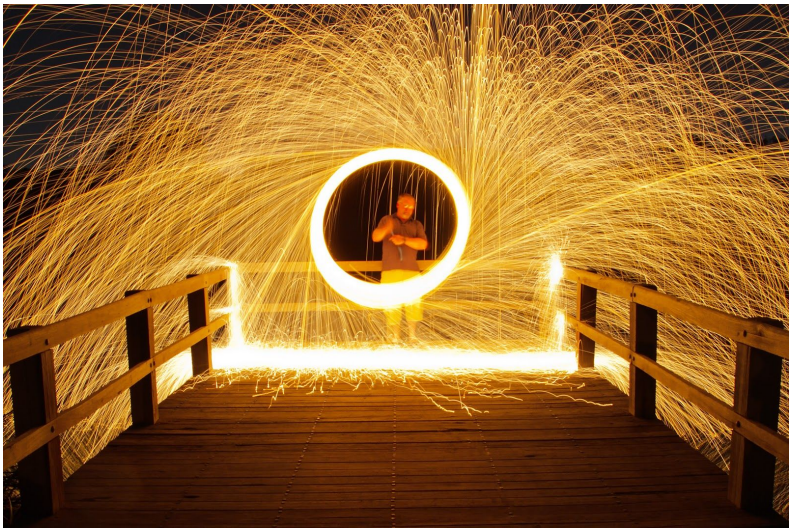
While bouncing light is a tool in the photographer's bag, light being bounced is still beholden to the properties and behaviors of light that were discussed earlier. For instance, the texture of the surface may diffuse, or scatter, the light that strikes it both softening and reducing the total light that reaches the subject. The surface may absorb or transmit certain wavelengths of light resulting in a color shift in the light that reaches the subject.

Finally, light that is bounced is still subject to the Inverse Square Law. Photographers must take into account the distance from the flash to the object that the light is bouncing from as well as the distance between the bounce object and the subject when determining the amount of power to apply to the flash. The photographer will only be able to use either automatic or manual modes when bouncing light.

Diffuser: When discussing reflection in section 102.4.3 we talked about how light reflects off of a surface at the same angle that it hits that surface. When a focused beam of light hits a material that scatters light, it is diffused. A diffuser is a material that scatters and softens light. This diffused light creates a slow falloff in shadows and causes light to "wrap" around objects. Any object that softens light can act as a diffuser, but some of the most common are diffusion cloth, cheese cloth, and frosted plastic. Photographers must remember that diffused light, just like bounced light will lose its intensity and must be compensated for.

Direct: Direct flash is directly as its name would imply, flash pointed directly at the subject. Direct flash only deals with the direction that the light hits the subject, not the quality of light i.e. either diffused or undiffused.

Painting With Light: Painting with light is a photographic technique where a photographer exposes a long shutter speed image while physically and intentionally moving a light source through the frame.



The images that can be created by a photographer painting with light are only limited by the photographer's imagination and the light sources that the photographer has access to. As the image above demonstrates, painting with light does not have to be accomplished with traditional lighting instruments, anything that generates light can be used.

Photography

The discussions of light and color theory earlier in this guide have been setting the groundwork for the practical application of this knowledge. Photography is one of the many skillsets the Sailors with NOS B610 are expected to be able to accomplish both skillfully and artfully.

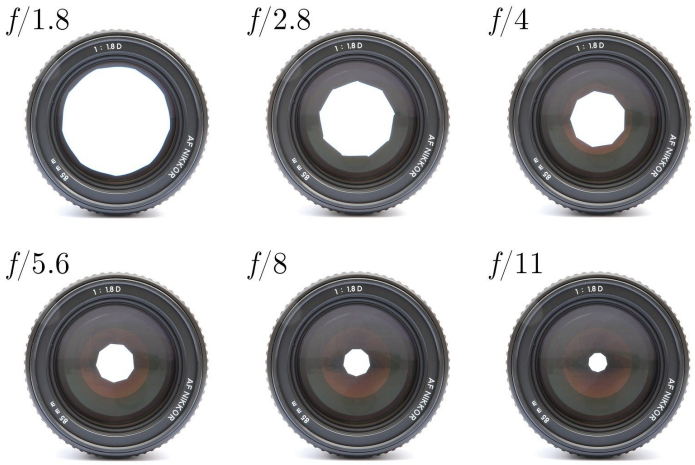
Photography is the process of producing images by the reaction of radiant energy, particularly light on a sensitive surface (Websters). Traditionally this has been accomplished through the use of a camera which focuses light on a photographic emulsion, or light sensitive film. Throughout the history of photography, different emulsions, formats and processes were used to accomplish this imagery. 2003 marked a major shift in the field of photography as it was the first time that digital cameras outsold their film counterparts.

Digital cameras, which have become the standard within the Department of Defense, will be the primary photographic tool that you will use. Regardless of the capturing technique, either film or digital, the principles behind the operation of a camera have remained constant. Understanding these principles, the photographer will be able to understand how their camera works, and how to best use it to capture images.

Discuss exposure and how it relates to the following:

To understand exposure, and the variables that constitute it, you have to have a basic understanding of how a camera functions. To produce an image, a camera directs and focuses light from a scene onto a photoreactive emulsion, or in the case of modern digital cameras, the sensor. Lenses manipulate the light creating an image that passes through the aperture, or small opening, to focus that image on the sensor. The shutter controls the time that the sensor is exposed to the light. This works in conjunction with the sensitivity of the sensor to impact the overall image.

Aperture: After light enters the lens the first element that controls exposure that the light encounters is the aperture. In its simplest terms, the aperture of a lens is a restrictive opening that varies in size to regulate the amount of light that passes through to the sensor. Aperture is assigned a value that is referred to as an f stop. Large f stop values refer to a small opening in the aperture whereas a small f stop number represents a large opening of the aperture. So f1.4 will allow significantly more light to reach the sensor than an aperture of f22.



For aperture size to be of photographic use in calculating exposure, there needs to be a way to determine the amount of light that is striking the sensor and how changing the size of the aperture affects that light. Fortunately, our lenses are typically marked in single stop increments. What this means is that moving one stop down the scale from f2.8 to f4 would result in a reduction of half the amount of light hitting the sensor.

Shutter Speed:

Sensitivity:

Discuss the following metering techniques:

Spot:

Center-weighted:

Average:

Partial:

Discuss how the following may affect image quality:

ISO:

Resolution:

Compression:

Discuss camera color settings

Discuss auto and manual focus

Discuss zoom lenses

Discuss prime lenses

Discuss how lenses affect the following:

Focal length and image size:

Focal length and subject coverage:

Angle of field:

Angle of view:

Compression:

Depth of Field:

Foreground/Background:

Discuss shooting with natural light in the following conditions:

Daylight:

Low Light:

Night Time:

Discuss the fundamentals of composition

Rule of thirds:

Balance:

Leading Lines:

Symmetry:

Patterns:

Viewpoint:

Background:

Foreground:

Depth of Field:

Framing:

Contrast:

Discuss the importance of each of the following:

Control your background:

Fill your frame:

Wait for moments:

Discuss and discuss the use of histograms

Discuss studio requirements for the following:

Navy special programs packages:

Officer full lengths:

Roster board/Biography studio portraits:

Passports:

ISOPREP:

Discuss studio setup and layout

102.7.15 Discuss the following components of a caption

VIRIN/Vision ID:

5Ws and H:

Dateline:

Credit line:

Discuss the following components of IPTC metadata

Caption:

Keywords:

Release Authority:

Classification:

Discuss and discuss the photography categories represented in the Navy Media Awards program.