

LIGHT AND LIGHTING

GUIDE



Ontario Police College
Identification Training

Module P-6

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INTRODUCTION

RATIONALE

Identification Officers photograph subjects in natural and artificial light. The photographic emulsions they use are sensitive to portions of the electromagnetic spectrum. The ranges of their sensitivity vary and they are designed to react in specific ways with certain wavelengths. To control light to optimize its photographic potential, it is essential to have a basic understanding of its place within the electromagnetic spectrum and to understand some of its behaviours and characteristics.

PREREQUISITES

- Introduction P-1
- Exposure P-5

WHAT THIS MODULE CONTAINS

- GUIDE - this booklet, a resource guide
- ACTIVITIES - the booklet of practice activities
- ACTIVITY CHECK-OFF SHEET - a progress report
- CRITERION TEST - a test instrument

HOW TO WORK THROUGH THIS MODULE

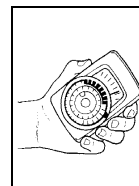
- read the objective to discover what you will attain for your efforts
- gather the resources listed in this guide
- examine the Criterion Test to learn how you will provide evidence of attaining the objective
- start reading this guide and follow written instructions

The material in the Guide and the Activities booklets, although integral parts of this training package, are by no means adequate by themselves to ensure success. Study the resource material. The resources have been carefully selected for their relevancy to the objective.

THINGS YOU WILL NEED

- hand-held exposure meter

LIGHT AND LIGHTING



OBJECTIVE:

Given lights and lighting accessories, exposure meter, and study materials, at the end of the session the student will be able to control exposure and contrast to the extent that the student will be able to: recognize the behaviour and characteristics of arranged and natural lighting, take advantage of favourable lighting conditions or employ corrective techniques, controls and equipment to optimize the quality of the photographic image; as evaluated by the facilitator.

KEY CONCEPTS:

- travels in straight lines
- angles of incidence and reflection
- shape, texture
- hard, soft, medium light
- lighting & subject contrast
- colour temperature, Kelvin, primaries, complementaries, filters
- film latitude, film response
- variables of contrast effect
- directionality of lighting, strength
- time of day, weather, seasons
- types of lights
- tungsten, tungsten-halogen, quartz, reflector
- floodlights, umbrellas, bounce light
- reflector, ratios, diffusers, painting
- baffles, screens, flags and snoots
- angle of incidence, relative intensity, light balancing
- inverse square law specularly, diffused light
- single dominant source
- modelling, texturing, colouring, brightness ratio, tonal composition
- lighting control
- main, fill, accent, background lights
- fast film, slow shutter
- relative camera position, angle of incidence
- soft, pastel shades, cold, blue cast

RESOURCES

Video: *On Assignment: Photographic Light*

(Cassette #1)	(Cassette #2)
Nature of Light	Contrast
Direction	Colour
Form	(Cassette #5)
	Natural Light

Book: *Nikon F-601 Instruction Manual*

Book: *Introduction to Photography, Glossary*

Book: *Photography, Art And Technique*

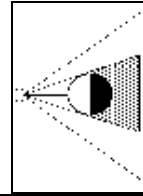
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Book: *Using Your Autofocus 35mm Camera, KW-11*

Book: *Introduction to Photography*

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LIGHT AND LIGHTING



Natural light may be defined as continuous light emitted by a natural source such as the sun. Luminescence, which comprises fluorescence and phosphorescence, is natural light but distinguishes itself by the fact its light emission is induced. This will be examined in greater detail in a separate module concerned with ultraviolet and infrared.

Continuous artificial light generally refers to a human-developed incandescent or fluorescent source whose duration of light emission is controlled by the photographer, unlike electronic flash where the photographer triggers a flash of extremely brief duration.

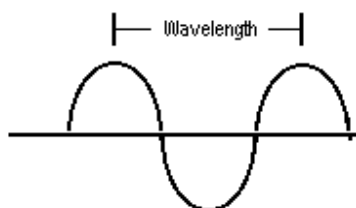
Light is energy in motion; it remains invisible as it travels through space. It becomes apparent only when light strikes an object and illuminates it. It was discovered that this energy vibrates in all possible right angles to its direction of travel. The significance of this discovery will become apparent when we examine polarizing filters. Light, alone, can stimulate the two types of receptors within the eye to permit vision and it is the instrument of construction of photographic images.

Within a broad spectrum of radiant electromagnetic energy, light occupies a very narrow band. Light travels at 300,000 kilometres per second and that speed will change only slightly as light travels from one medium to another (e.g., from air to glass or water).

Light and Energy

Electromagnetic energy is a form of energy as is thermal, chemical, kinetic and electric. It exists only in the form of repeating wave patterns travelling in straight paths. Its rays emanate in all directions from its source. Light being a special form of radiant energy, is also called visible radiant energy, or the visible spectrum.

Transformed from thermal energy to radiant electromagnetic energy, light travels at high-speed in a high-frequency wave form and becomes useful in the visual sense when a sufficient amount of it is transformed into chemical energy within the receptors of the eye

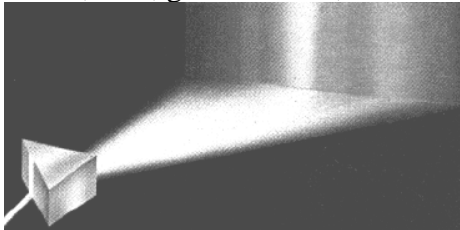


or the emulsion of a film. The spectrum of radiant energy waves we call *light* is very narrow, ranging from approximately 380 nanometres to 760 nanometres. **Wavelengths** are determined by measuring the distance between consecutive crests of energy waves and, for radiant energy, wavelengths are expressed in nanometres. A nanometre is one billionth of a metre. Within this small

visible part of the spectrum, there are three primary colours: red, green and blue. These colours or hues combine to form white light. Wavelengths which are shorter than 380nm or longer than 760nm do not stimulate the receptors in the eye and we experience darkness. *Ultraviolet* energy, found below 380nm, and *infrared* energy, beyond red, longer than 760nm, are two examples of radiant energy invisible to us yet useful in certain kinds of photography. Our sun and electric lamps are among several light sources that emit ultraviolet and infrared. The figures 380nm and 760nm, the frequency range of the visible spectrum, are usually modified by rounding to 400nm and 700nm.

The Spectrum and Spectral Distribution

A light source emitting radiant energy relatively balanced in all visible wavelengths will appear white to the eye. However, passing a narrow beam of white light through a prism of transparent material will *disperse* or separate and spread the individual wavelengths of visible energy. The eye can now see the colour spectrum as three wide bands of blended colour, blue, green and red, with narrower bands of cyan, yellow and orange.

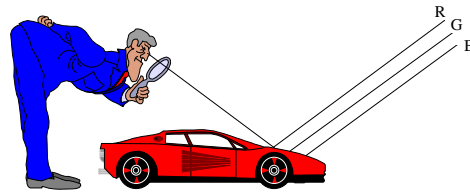


The colours separate in specific order, however. In the illustration, from left to right, the colours are red, orange, yellow, green, cyan and blue. If a subject transmits or reflects all three *additive primaries*; red, green and blue, with equal intensity, the subject is said to be white or neutral. White, gray and black are *neutrals*. They exhibit

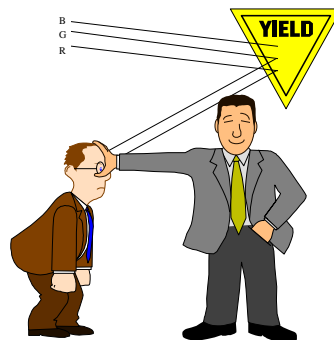
no colour bias. Their apparent differences lie with light intensity; not colour. Gray is brighter than black and white is brightest. Each absorbs and reflects all colours equally. If a subject reflects or transmits one or more hues, partially or completely, the subject is seen as the colour of this hue or combination of hues.

But there are more hues than red, green and blue! So, how do the other colours of the spectrum appear? Dispersion of white light gives us a clue. White light is broken up into its three additive primaries of red, green and blue. Where the red and green merge, yellow is produced. Where the green and blue merge, cyan appears. As red and blue are at opposite ends of the visible spectrum, they cannot merge naturally, but if we force a combination of equal intensities of red light and blue light, magenta will be formed. *Yellow, cyan and magenta* are called *subtractive primaries*.

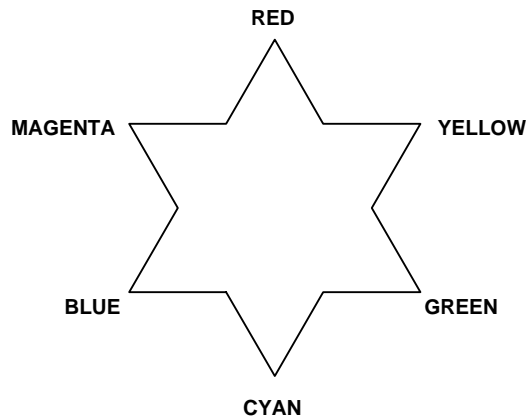
We can deduce that we see a car as red under white light because red is reflected while green and blue are absorbed.



A yield sign is yellow because blue light is absorbed and red and green are reflected. Red and green light combine to form yellow. This is not true for pigments. Mixing red and green paint will not produce a yellow sign. Yuk!



If we were to place each of these hues on a six pointed star, with red at the top, and the remainder in their relative positions; moving clockwise from red, there would be: yellow, green, cyan, blue and magenta.



Red, green and blue are additive primaries. Yellow, cyan and magenta are subtractive primaries. Opposites, e.g., yellow and blue are complementaries.

Opposite colours (red and cyan, for example,) are called **complementaries**. The complementary of magenta is green. Magenta and green are complementaries. Combining complementaries produce neutral, either white, gray or black. Well, it will be white, gray or black depending on its luminosity (brightness). But why neutral? Let's take the magenta/green example above. Magenta is a combination of red and blue. Now add green light. **Red+Blue+Green = Neutral!** Another way of arriving at the same place is to consider green is the mergence of yellow and cyan; $M+Y+C = N$.

White light is the product of a mixture of fairly equal proportions of blue, green and red light. If there is a severe imbalance of **spectral distribution** the light will not appear white, for example:

- a household tungsten lamp appears yellow;
- a butane/propane flame appears blue;
- a candle flame appears yellow.

Spectral quality refers to the mixture of primary colours to produce light. A match flame is low in blue and high in red; a blue sky is low in red and high in blue. Spectral Quality is expressed in Kelvin, the match flame would relate to a low Kelvin temperature (also called colour temperature), i.e., 2000K, whereas the sky would have a colour temperature of approximately 12,000K. Kelvin is not a measure of heat. Kelvin expresses colour of light. See *Introduction to Photography*, p.130.

Light source	Colour temperature
Standard Candle	1930
Dawn Sunlight	2000
Household Tungsten Lamp	2800
Warm White Fluorescent	3000
Photographic Lamp	3200
Photoflood Lamp	3400
Daylight Fluorescent	4500
Mean Noon Sunlight	5400
Electronic Flash	6000
Blue Sky	10000 to 18000

The colour temperature of a light source has particular importance with regard to colour photography and the general effect colour temperature of lights has on our perception of colours. As the light source changes, the apparent colour of objects change also.

We can identify colours if the light source falls within the range of

2800K to 6000K. Since the human concept of white light covers such a broad range of spectral distribution, it should be apparent that we are not very discriminating in our subjective assessment of what constitutes white light. With light sources of low colour temperature, i.e., 2000K, we should recognize the reddish cast imparted to colours and at 10,000K and we should recognize the bluish cast imparted to colours. The eye can clearly identify colours correctly in daylight viewing conditions, 5500K, and less accurately as the colour temperature of the light source either increases or decreases.

Ever wonder why witnesses sometimes differ in their opinion about the colour of a vehicle under some of our street lamps? Clear mercury vapour is a light source deficient in red. As a result red or reddish objects may appear neutral. Sodium vapour lights may be deficient in blue and as a result bluish colours may be identified as neutrals.

Where a viewer is already familiar with the colours of certain objects, a different phenomenon referred to as *colour constancy*, may occur. Colour constancy persuades the eye to identify colour as though the illumination was from a white light source, irrespective of the actual colour of the light source. For this to happen the viewer must be precognizant of the object's colour.

In addition to spectral distribution, low light level is the second factor which affects our ability to identify colour. Under low levels of illumination, most of our seeing is through the sensors called rods; these sensors cannot identify colour and they register images with less resolution. In such situations, colours become less saturated and their hues shift toward the blue (moonlight appears bluish) due to rod input.

Behaviour Of Light

One attribute of light, is its ability to travel through a transparent medium and to follow its contours irrespective of the medium's shape. This is sometimes referred to as **light piping**. Fibre optics makes use of this principle. Film manufacturers recommend loading roll film in subdued light. This is a precaution against the potential for light rays to enter the edge of the film and follow the contours of the film rolled inside the cassette, causing unintentional exposure.

Light falling on matter reacts in a number of ways; the reaction is dependent upon the direction of the incident light relative to an object, its surface, whether it is smooth, textured, transparent et cetera and colour of the incident light and the object. Some of the more important behaviours to us as photographers are: **absorption, specular reflection, diffuse reflection, direct transmission, diffuse transmission, refraction and dispersion.**

View the topics listed in your resources under Video: *On Assignment: Photographic Light* (Cassette #1). In the activities section of this module you will be asked to define the behaviours mentioned in the previous paragraph. You may consult the *Glossary of Photographic Terms* to complete this activity.

Turn to the Activities booklet now and complete Activity One.

Examine Activity Two to see what will be required. I suggest you view video cassette #3 on *Photographic Light*. Next, study the resource topics in *Introduction to Photography* and *Photography, Art and Technique*.

Turn to the Activities booklet now and complete Activity Two.

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