Introduction

Photography is a two dimensional fine art medium similar to painting or drawing. Although there are many differences between them, the final product is usually a rectangular shaped image that defines an idea or emotion. Because of this similarity, the camera and other tools used for photography can be compared to the brushes, canvas, and easel used for painting. As a consequence, the student must understand the tools of photography to make photographs to the same extent a painter must understand the tools of painting in order to paint.

The technical knowledge required to make a good photograph is not extraordinary. Just as there are few good painters who understand how to manufacture paint, there are few good photographers who understand how to build a camera. The goal of this assignment is to provide the student with a basic understanding of how photography "works", and what tools are used to craft a final image.

Very Basic Basics

NOTE: I've taken some technical liberties to assist in the explanation

Black and white photographs are images created by metallic silver. Have you ever noticed how a silver tea service can tarnish and discolor? This action is caused by having silver in contact with air and light. Just as your car fenders rust out and turn orange, silver rusts out and turns black. This action is the basic component of black and white photography, so repeat after me:

"Silver salt crystals turn black when exposed to light"

The black and white films used for this class contain silver. The silver is placed on the plastic film strip by mixing it with a Jell-O like substance that hardens on the clear plastic film strip. This hardened Jell-O compound containing the silver is called an "emulsion". Film manufacturers mix up the emulsions to meet specific film needs. Some emulsions are very sensitive to light and are called "fast" emulsions or films. Some are very insensitive to light and are referred to as "slow" emulsions or films.

Film and Film Speeds

Film manufacturers have various recipes for emulsions that change how sensitive they are to light. Sensitive films require very little light (exposure) to turn them black. This type of film is generally referred to as a "fast film", and has a high ISO number such as 1000 or 3200. Less sensitive films require much more light to turn the silver black. This type of film is often referred to as "slow", and has a typical ISO number of 25 or 64.

To acquaint you with film speeds and how they are different, think of how the sun affects your skin. You may have a friend whose skin burns after only a few minutes in the sun. Call this "fast" skin that is sensitive to light. Another friend may be able to spend all day outside without turning pink at all. Call this "slow" skin that is very insensitive to light.

The "cooks" who make emulsions vary the film speeds by changing the size of the silver salt
crystals that turn black. The larger the crystals, the more sensitive they are to light. Fast films require relatively large silver salt crystals, whereas slow films use relatively small silver salt crystals. The crystals within the emulsion often give the photograph a texture or pattern that is referred to as "grain". Fast films often produce images with noticeable texture and are called "grainy". As a result, fast films that are used for low-light photography can often be identified by the appearance of grain in the image.

**NOTE NO. 1: FILM SPEED IS THE FIRST BUILDING BLOCK OF EXPOSURE**

**What is Exposure?**

Exposure is a term often used in photography. It refers to the **amount** of light that falls upon the film. Life and photography would be much easier if we could measure the amount of exposure as though it were water:

"One quart of light for this photograph, please".

But unfortunately for the beginning photographer this is not to be. Exposure is measured as a quantity, but there is no single unit of exposure that reflects the amount. Exposure is a combination of **time** and **intensity**. To illustrate this relationship, think about measuring a quart of water using two different sources to fill up the container. One source of water is the faucet in the top floor of a fifty year old apartment building. The other source of water is a fire hose.

- Which source could fill up the one-quart container the quickest?
- Which container contains the most water?

**Intensity** is simply brightness. The brighter the scene or subject, the less time it takes to correctly expose the photograph.

**NOTE NO. 2: INTENSITY IS THE SECOND BUILDING BLOCK OF EXPOSURE.**

**NOTE NO. 3: TIME IS THE THIRD BUILDING BLOCK OF EXPOSURE.**

**Where Do We Measure Exposure?**

Considering what we have learned above as it relates to film and exposure, imagine yourself making a photograph of a tea pot in two different locations. The first location is in the Sahara Desert in the middle of summer at high noon, without a single cloud present. How would you describe the intensity? The second location is at the far end of a coal mine shaft in Tennessee. Now it might be intense in there, but not for light!

Because the **available** light in each scene determines the exposure, we must measure the brightness of each scene to correctly set the camera controls.

**NOTE NO. 4: EXPOSURE IS DETERMINED BY THE AVAILABLE LIGHT ON THE SCENE.**

**How Do We Give the Film the Correct Exposure?**

The camera has two basic controls that can regulate exposure:

1. The **shutter** which controls the amount of time that light reaches the film.
2. The APERTURE which controls the INTENSITY of the light reaching the film.

The shutter on a 35mm SLR camera is usually located towards the back of the camera just ahead of the film. It acts like a door that opens and closes across the film. The shutter contains a timer that regulates how long the shutter is open. This timer regulates the "shutter speed" in fractions of a second. The control for this function is usually on the very top of the camera, just to the right of the viewfinder.

"Shutter Speeds" refer then to the amount of time that the shutter is open. Although they represent fractions of seconds, the speed is usually indicated by only the lower half of that fraction. 1/15th of a second is listed as "15" on the shutter speed dial, whereas 1/250th of a second is listed as "250" on the shutter speed dial. A larger number means a faster speed, and a correspondingly smaller amount of time. Why do you suppose each number is approximately doubled for each adjacent change in speed?

The aperture refers to the opening created inside the lens by a device called the DIAPHRAGM. The diaphragm is a series of metal blades that move together to form the aperture opening. As the aperture opening becomes smaller, the amount of light that passes through the lens is reduced in INTENSITY.

If you were photographing a scene in the Sahara Desert at high-noon on a cloudless day, would you have a relatively small aperture opening? If you were photographing a scene in a coal mine at night, would you probably have a relatively large aperture opening?

Instructor: Have the students do the pupil test at this time.

The aperture opening size is controlled on most camera lenses by a ring on the outside of the lens that has some of the following numbers on it: 5.6, 8, 11, 16, and sometimes 22. The numbers refer to the relative size of the aperture opening in relationship to the focal length of the lens. The smaller number refers larger lens opening, while the larger number refers to a smaller lens opening. This was accomplished for no other reason than to simply confuse the beginning photography student.

In reality, each adjacent number refers to a specific change in the intensity of light reaching the film. Moving the aperture control ring from the 5.6 position to the 8 position makes the aperture slightly smaller in diameter, and reduces the light intensity by one half. Moving the ring from 8 to 11 reduces the intensity by one half again.

Remember how the shutter speeds changed by one half for each adjacent number? Do you think we’re on to something here? Well, you’re right! Each change in aperture setting either doubles or halves the intensity of the light depending upon which way it is turned. Each change in shutter speed either doubles or halves the amount of time the shutter is open, again depending upon which way it is turned. Because our formula for exposure is…

\[ \text{EXPOSURE} = \text{TIME} \times \text{INTENSITY} \]

…then any correct exposure can be made with a various number of time and intensity combinations. To simplify this formula, let's assume that a 400 speed film requires 100 units of exposure. We could have a number of time and intensity combinations that will equal 100:

\[ 100 = 4 \times 25 \]
\[ 100 = 2 \times 50 \]
100 = 20 x 5

Just as in the sample above, the aperture and shutter speed can be combined with different settings to achieve the same exposure. Because the value of the exposure is DETERMINED by the available light, we can use the following Sahara Desert at high noon or DARN BRIGHT as an exposure value:

DARN BRIGHT = f5.6 @ 1/500TH OF A SECOND
DARN BRIGHT = f8 @ 1/250TH OF A SECOND
DARN BRIGHT = f11 @ 1/125TH OF A SECOND

Taking our camera into the coal mine at night reveals a exposure value of AWFUL DARN DARK. The camera can handle this to, but at a much different combination of settings:

AWFUL DARN DARK = f5.6 @ ½ SECOND
AWFUL DARN DARK = f8 @ 1 SECOND
AWFUL DARN DARK = f11 @ 2 SECONDS

How Does the Camera Know What the Correct Exposure Is?

Just as your car has a speed-o-meter to tell it how fast you’re going, most cameras have a light-o-meter to tell you how much available light it sees on the scene. Well, its called a light meter, not a light-o-meter, but I have always liked the way the second version sounds so art deco. Light-o-meter…… just imagine the following:

_Buck Rogers points his chrome space ship (which looks like a flashlight with fins) at the stars and presses the ignition button. The rockets roar to life and propels Buck and his crew into the black void while he guides its course with what appears to be the steering wheel from a Buick. The crew frantically throws levers and valves that have been salvaged from an ocean liner. Buck calls out: "Set the light-o-meter for a course to Nebulon Seven"._

The light meter isn’t very Buck Rogerish, but it does tell you how to set the camera controls. The light meter is connected electronically (on most cameras) to the shutter speed dial and the aperture control ring. As the light meter senses the brightness of the scene that you view through the camera, it indicates with some type of display whether or not the controls are set correctly. Each type of camera is slightly different in the approach it takes to accomplishing this. Here are a few examples:

1. A "match-needle" exposure meter that has two moving needles that pivot from the same point. As you move the shutter speed dial or aperture control ring, the needles move apart or together. The correct exposure is reached when the needles are together (matched).

2. Glowing LEDs. This type of meter usually has red and green lights within the viewfinder that glow to indicate correct exposure. As you adjust the shutter speed dial or aperture control ring, the lights may change from red to green, indicating the correct exposure.

3. LCDs. Modern cameras may have a liquid crystal display both within the viewfinder and on the top of the camera. The numbers presented in the display
usually indicate what the camera settings are, and may determine what the correct exposure is. Almost every type of modern camera has taken a different approach to this type of meter, and requires the user to check the owner’s manual to determine how to use each setting.

BEFORE the camera light meter can be used to determine what camera control settings are important, it must be programmed for the type of film that is being used. If the film is relatively slow and less sensitive to light, the meter will suggest shutter speeds and aperture settings that allow the film to receive more light. If the film is fast and sensitive to light, the meter will suggest settings that allow the film to receive less light.

The film speed must therefore be set on the camera by the user. This is usually accomplished by turning a "film speed dial" that is located on the top of most cameras. Numbers on the film speed dial correspond to the ISO film speed that is labeled on the outside of the film container. Kodak TRI – X film is rated at ISO 400. For the camera to correctly use this film, the film speed dial must be set to 400 as well. A number of modern cameras now include a electronic device within the camera that can read the film canister to determine what the film speed is. If your camera is equipped with this type of device, it will automatically set the correct film speed on the camera when you load the film.

Is This All There IS?

No, This is only scratching the surface. But it does allow the student to begin using the camera with the ability to correctly expose the film. Many of the other camera controls are intuitive to use and understand, such as focus control, film advance, and the self timer. Film speeds, shutter speeds, aperture settings, and exposure meters are basic aspects of photography that once understood become like canvas and brushes to the painter. Please refer to this handout often as you learn more about using your camera.