SUBCOURSE SS0508

EDITION 8

PHOTOGRAPHIC FILTERS AND TECHNIQUES

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM

A I P D

READINESS / PROFESSIONALISM THRU GROWTH

US ARMY STILL PHOTOGRAPHIC SPECIALIST
MOS 84B SKILL LEVEL 1 COURSE

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US Army Signal Center and Fort Gordon
Fort Gordon, Georgia

GENERAL

The Photographic Filters and Techniques subcourse is designed to teach tasks necessary to the production of good photographs. SS0507 gave you the principles of photography. Now you will learn exposure, filters, composition and perspective in more detail. This information combined with the operation of a camera will help you produce the best possible photographs.

Lesson 1: DETERMINE PHOTOGRAPHIC EXPOSURE

TASK: Identify the procedures and techniques of determining photographic exposure.

CONDITIONS: Given information and diagrams pertaining to the calculation of photographic exposure.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to a minimum of 80 percent of the multiple-choice test covering the determination of photographic exposure.

(This task supports SM Tasks 113-578-1005, Photograph Subjects with a 35 mm Single Lens Reflex Camera; and 113-578-1007, Obtain Light Readings Using a Photoelectric Light Meter.)

Lesson 2: PHOTOGRAPHIC FILTERS

TASK: Describe the theory of photographic filters, their general construction, and their proper use in black-and-white photography.

CONDITIONS: Given information and diagrams pertaining to the theory, construction, selection, and use of photographic filters.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to a minimum of 80 percent of the multiple-choice test covering the theory of photographic filters, their general construction, and their proper use in black-and-white photography.

(This objective supports SM tasks 113-578-1014, Alter the Rendition of Colors Recorded on Black-and-white Film; and 113-578-1016, Alter Light Radiations to Match Color Films.)

Lesson 3: PRINCIPLES OF PHOTOGRAPHIC COMPOSITION AND PERSPECTIVE

TASK: Identify the procedures and techniques of employing photographic composition and perspective.

CONDITIONS: Given information and diagrams pertaining to the theory of photographic composition and perspective.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to a minimum of 80 percent of the multiple-choice test covering the procedures and techniques of employing photographic composition and perspective.

(This subcourse supports SM tasks 113-578-1015, Employ Photographic Composition; 113-578-1013, Photograph Subjects Using Various Focal Length Lenses; 113-578-1019, Prepare for a Photographic Assignment.)

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*****IMPORTANT NOTICE*****

THE PASSING SCORE FOR ALL ACCP MATERIAL IS NOW 70%.

PLEASE DISREGARD ALL REFERENCES TO THE 75% REQUIREMENT.

Whenever pronouns or other references denoting gender appear in this document, they are written to refer to either male or female unless otherwise noted.

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INTRODUCTION TO PHOTOGRAPHIC FILTERS AND TECHNIQUES

These three lessons on photographic filters and techniques are designed to teach you the methods of using photographic filters, i.e., how they are used, how they are made, and what filters should be used with various films and in what conditions. This subcourse will also teach you photographic composition and techniques that will make your photographs the best possible. Your ability to use filters and compositional effects may well spell the difference between a good photograph and a bad photograph.

The term "visual information" has replaced "audiovisual" in the Army of Excellence.

LESSON 1
DETERMINE PHOTOGRAPHIC EXPOSURE

TASK

Identify the procedures and techniques of determining photographic exposure.

CONDITIONS

Given information and diagrams pertaining to the calculation of photographic exposure.

STANDARD

Demonstrate competency of the task skills and knowledge by correctly responding to a minimum of 80 percent of the multiple-choice test covering the determination of photographic exposures.

REFERENCES

TM 11-401-1

Learning Event 1:
DESCRIBE THE THEORY OF EXPOSURE AND EXPLAIN THE SIGNIFICANCE OF THE EXPOSURE FORMULA

1. When light strikes a piece of film a latent image (invisible image) is formed. This image is called "latent" because it cannot be seen in the film until it is "developed" by treating the film with special chemicals. The action of development causes the latent image to become visible in proportion to how much light struck the film in the first place. Those parts of the film which received a great deal of light darken considerably, while those struck by relatively little light darken only slightly. The striking of film by light is called "exposure" (fig 1-1).

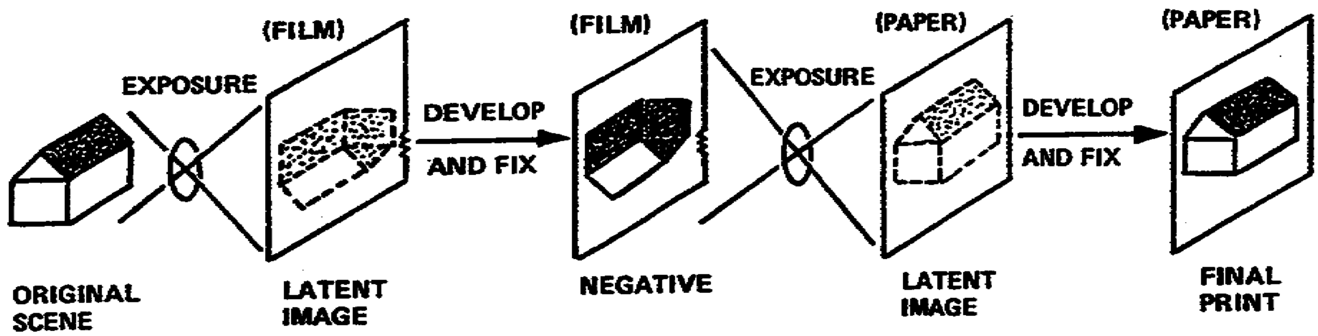


Figure 1-1. The photographic process

2. Exposing film is simple; just let light strike the film. But in photography, this is rarely useful. First, you usually want to record an image. Second, you want to record an image of varying brightnesses. (After all, if the brightness was the same everywhere, the image would be uninteresting - just a splotch of black, gray, or white.) So the problem of exposure becomes one of "how much?". Too little exposure, and important parts of the image do not receive enough light to be recorded; too much and the film is exposed until it is as dark as it can get and the image is eventually lost in a totally black negative. The problem of "how much?" involves several things, such as the brightness of the light, the type of film used, and the reflective characteristics of the objects in the scene. But before investigating all these factors, let's first look at ways to control exposure, then at ways to find the correct exposure.

3. Measuring light. As you read earlier, when more light strikes the film, the resulting image becomes darker. The problem then becomes one of finding out how much light will make the image neither too dark or too light. The correct amount of light must be accurately measured.

a. There are two requirements in measuring light; you must control the intensity (brightness) and the amount of time light strikes the film. Think of it as filling a bucket with water. The amount of water which finally winds up in the bucket depends on both how fast the water was running and how long it was allowed to flow before it was shut off. If you want to fill the bucket to a precise depth, you can do so by running the water rapidly for a short time, or by running it more slowly for a proportionally longer time. Either way, the bucket will have the same amount of water in it. When making an exposure, you want to "fill up" the negative until it is full, but no more. Just as overfilling a bucket won't make the water get any deeper (because it merely spills over the edge and runs away), adding more light than needed to make the negative turn black is also a waste. The negative won't get any blacker. In photography, the rate of flow of light is called intensity, and time is the length of time light is allowed to flow (fig 1-2). So the formula reads:

EXPOSURE = INTENSITY x TIME. (E = I x T).

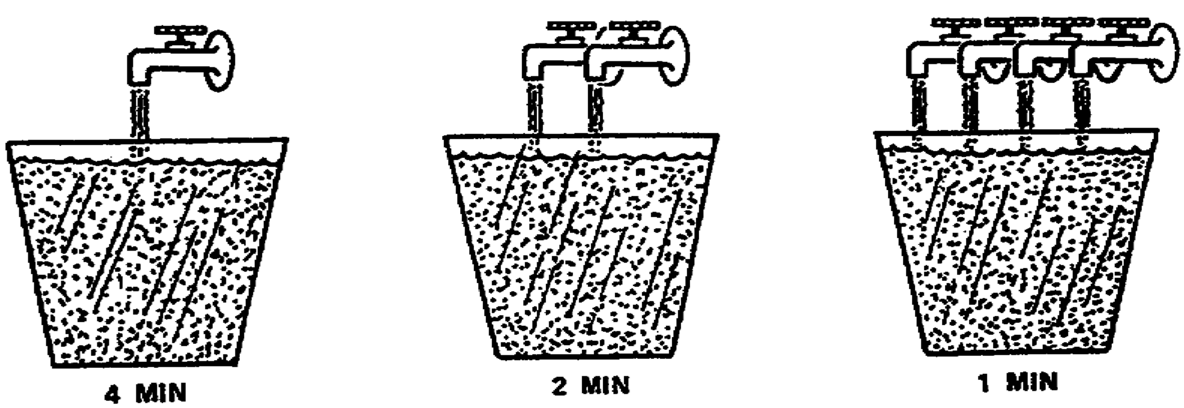


Figure 1-2. The principle of equivalent exposure

b. Think about the formula shown in Figure 1-2. If you have less light (intensity), then you must allow more time to get the same exposure. Or, if you have less time, then you must increase the intensity. It is obvious there are many combinations of time and intensity which will give the same exposure. Any two combinations which do this are called equivalent exposure. From the standpoint of merely darkening a piece of film, one equivalent exposure is just as good as any other. But there are artistic considerations involved in making a good photograph which can make one equivalent exposure distinctly better than another. You will learn more about this in Lesson 3.

Learning Event 2:
DESCRIBE HOW TO CONTROL LIGHT INTENSITY

1. You know you can control exposure by controlling intensity and time. But how is this done? Let's first talk about controlling light intensity.

a. A lens is a lot like a window. The bigger the window, the more light will come in. It's the same with a lens. The larger the opening in the lens, the greater the light's intensity on the film. And, like a window, you can control the intensity by opening and closing the opening in the lens (called the aperture). A diaphragm is the mechanism which opens and closes the aperture precisely, and provides for a numerical measure of the aperture opening.

(1) Early diaphragms were simply thin pieces of metal with various-sized holes in them. These holes allowed the photographer to adjust the amount of light passing through by selecting the hole size desired and inserting it in the lens' light path.

(2) Modern lenses use an iris diaphragm. This works much like the iris of your eye. A series of thin metal plates are assembled to allow the lens to open and close continuously (fig 1-3).

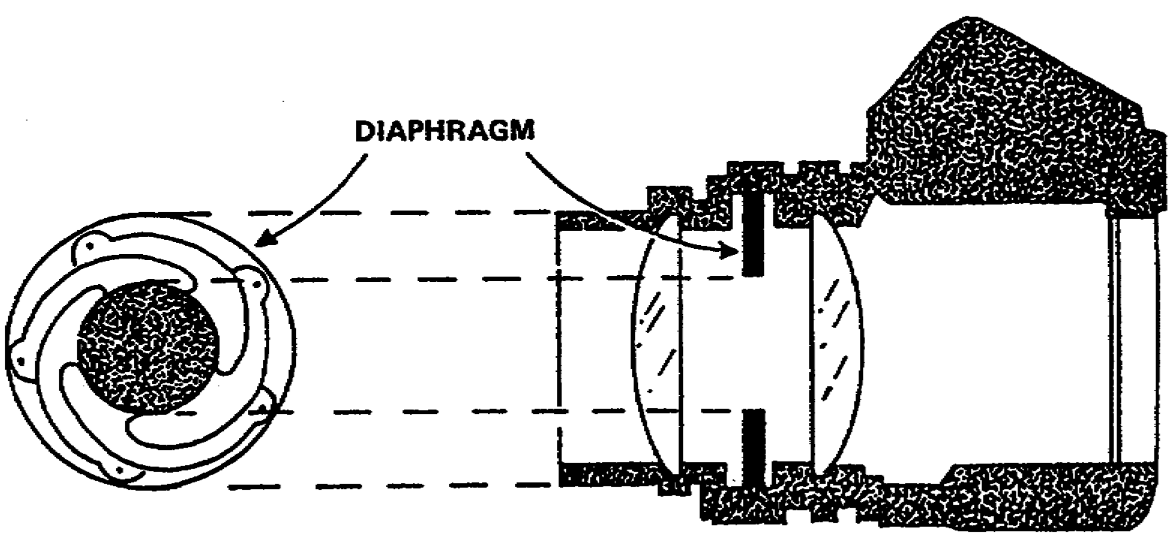


Figure 1-3. Diaphragm of a camera

2. How do you measure how open or closed a lens is? It might seem simple, but complications arise because photographers use lenses of different focal lengths. This means a 100-millimeter lens is twice as far away from the film as a 50-millimeter lens when both are focused on the same distance. And, just as with a window, the further away the film is, the less light will fall on it (fig 1-4). Is there any way to express how much light is falling on the film regardless of the focal length?

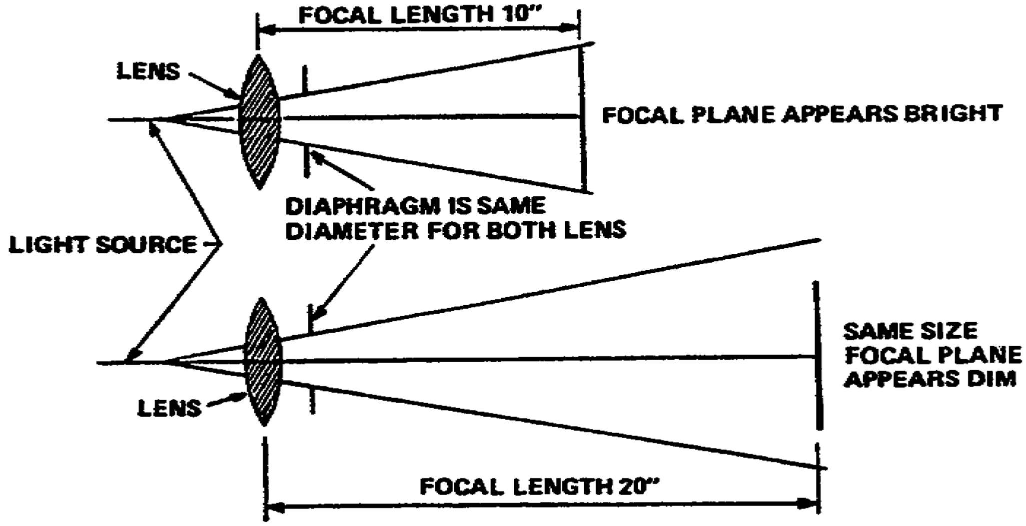


Figure 1-4. How image brightness is affected by focal length

a. The way to know how much light is falling on the film is through the use of the f/number system. An f/number is the ratio of the lens' focal length to the diameter of the lens' aperture (fig 1-5). For example, if a lens of one-inch focal length also has an aperture diameter of one inch, its f/number is 1; if a lens of two-inch focal length has a diameter of one inch, the f/number is 2. To make it clear that it is an f/number when writing, it is written as f/1 or f/2. The "f/" stands for "focal length divided by:" and f/2 literally means "the lens focal length divided by 2" (fig 1-6).

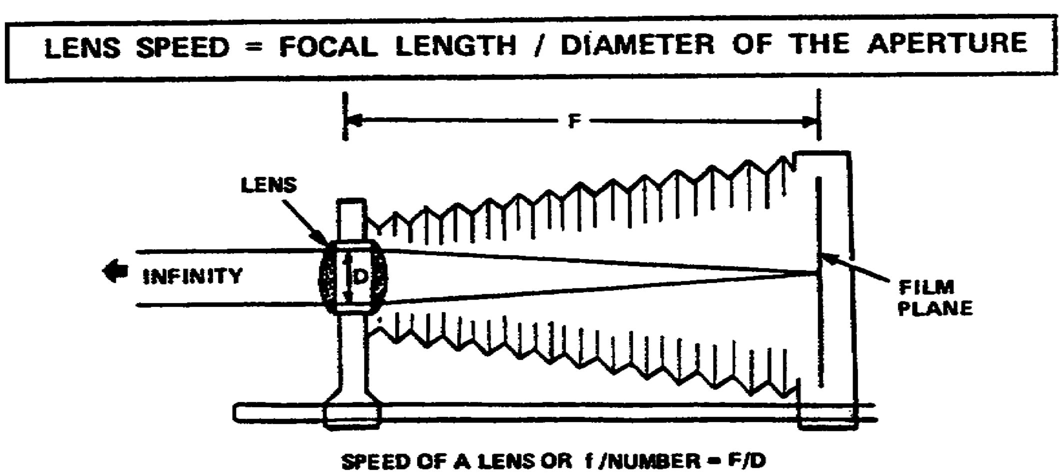


Figure 1-5. The f/number of a lens

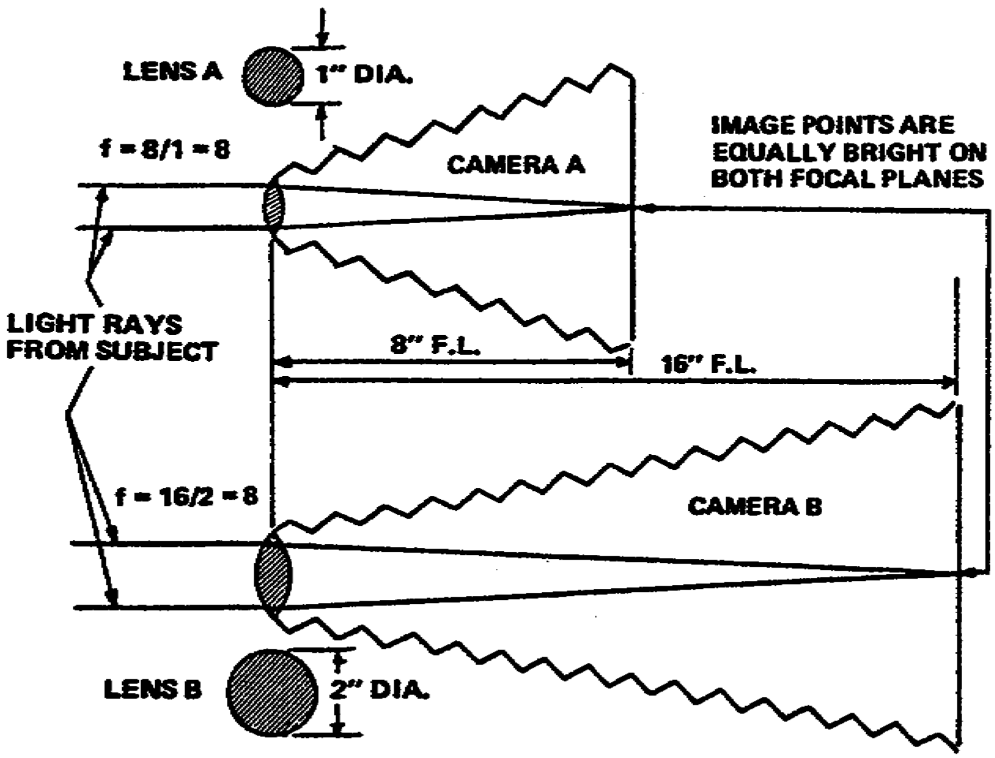


Figure 1-6. Equal f/numbers produce equal intensities

b. When photography students first encounter the f/number sequence engraved on a lens, they are usually a little put off because it looks more complicated than it really is. Look at the f/number sequence beginning with f/1 in Table 1-1.

SHUTTER SPEED:	1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250
F–NUMBER:	32	22	16	11	8	5.6	4	2.8	2

Table 1-1. The standard sequence of whole f/number

c. The standard sequence is one which every photographer must know by heart. Each number represents a change in the intensity of the light by a factor of 2. As the numbers increase, the amount of light passing through the lens decreases to half that of the previous f/number. That is, if the lens was initially set at f/5.6 and it is changed to f/8, the light passing through has been reduced exactly in half; and if the setting is changed from f/8 to f/11, the light is cut in half again, and from f/11 to f/16, in half again. The reverse happens when changing from a large f/number to the next smaller number. For example, a lens setting changed from f/32 to f/22 exactly doubles the intensity of the light, and from f/22 to f/16 doubles again. Remember, as the f/number increases, the light passing through the lens decreases because the aperture is smaller.

d. Look again at the f/number sequence, but this time, examine every other number. Notice that every other number is twice the value of its predecessor (Table 1-2). The two key numbers in this sequence are 1 and 1.4. The 1.4 is only approximate; actually it represents the square root of 2, which is closer to 1.4142135.

1	1.4	2	2.8	4	5.6	8	11	16	22	32	45	64	90

Table 1-2. Each doubling of the f/number results in a four-fold decrease in the amount of light admitted through the lens

e. Notice every second number is almost double in value. For example, 11 isn't exactly twice 5.6 and 45 isn't exactly twice 22, but if you remember that the actual number is 1.4142135, then 22 and 45 are very close to the true values. It's all those unwritten decimal places (they're still there, of course, even if they aren't written down) finally adding up enough to require an adjustment to the numbers (11 is actually a rounding off of 11.313708 and 45 is a rounding off of 45.254832.) This sequence should suggest which f/number comes after 90 and before 1; they are f/0.7 and f/128, respectively.

f. This doubling business is sometimes confusing. For example, a change of three f/numbers is sometimes thought to mean a change of exposure by a factor of six (2 x 3 = 6). But the real change is a factor of eight (2 x 4 = 8). Don't get confused by this, because the further you go, the worse the error becomes. A change of four stops, for instance, might be thought to be a factor of 8 (2 x 4 = 8), but it is actually 16 (2 x 2 x 2 x 2 = 16).

g. Exact f/numbers are often called stops because they "stop" light in exact ways. In practice, the term "stop" is used to indicate any change of exposure. "Stop" can refer to changing shutter speed ("Change your shutter speed two stops up."); or film speed ("A film which is twice as sensitive to light as another is termed 'one stop faster.'), as well as changing the lens opening.

h. Even though we have only discussed the sequence of whole stops, lens settings can easily be set at any intermediate point between numbers, allowing you to fine tune your exposures. Many lenses, especially on 35 mm cameras, are built so that as you move the f-stop ring, it will click into place at each f/number so that you can feel it with your fingertips. The ability to set the lens between these clicks is important because, as you will soon learn, you can't usually do this with the shutter. Stops are often referred to in fractional amounts, such as "open the lens 1 1/2 stops", or "ISO 64 film is 2/3 stops faster than ISO 40 film". You will learn what ISO means later in this subcourse.

Learning Event 3:
DESCRIBE HOW TO CONTROL TIME

1. Time is usually controlled by using a shutter. In the early days of photography, when exposure times were very long, cameras didn't need a shutter because the photographer could control exposure time by simply uncovering the lens for a few seconds (sometimes even minutes or hours) and then covering it up again. But as film emulsions became more sensitive to light, exposure times shortened dramatically. It soon became necessary to devise ways to slice time into very short lengths, even to thousandths of a second. Inventors have devised two basic types of mechanical shutters: leaf shutters and focal plane shutters.

a. Leaf shutters are built into the lens. They are made up of thin leaves of metal which are connected to a complex mechanism of gears and springs which make them open and close the light path through the lens (fig 1-7).

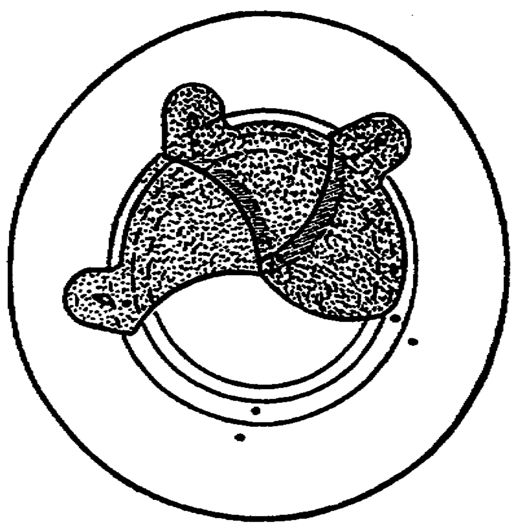
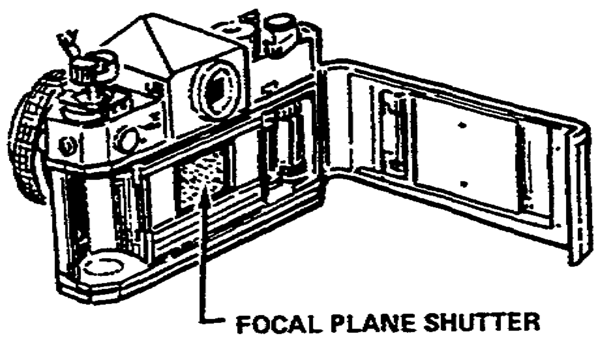


Figure 1-7. Leaf shutter

b. Focal plane shutters are cloth or thin metal curtains which are placed as close to the film plane as possible. They work by allowing one curtain to uncover the film plane and, after the selected time has passed, a second curtain to "chase" the first curtain across the film plane, recovering it (fig 1-8).



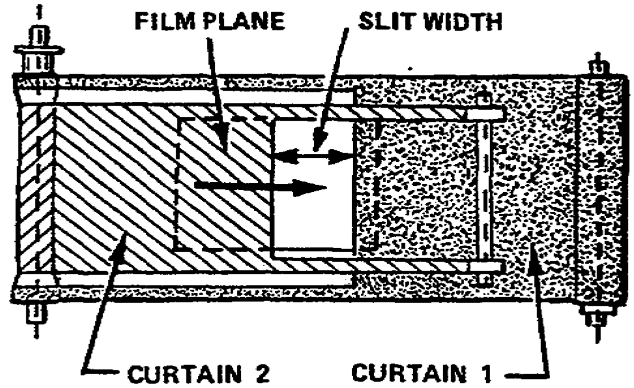


Figure 1-8. Focal plane shutter

2. Shutters are designed to allow the time to be changed by a factor of 2. That is, each change of shutter speed will alter the exposure time by either doubling it or halving it. It is no coincidence that shutter speeds are designed this way. Do you suppose that it has anything to do with the fact that f/numbers also work by doubling and halving? There are two common sequences of shutter speeds, depending on the type of shutter. The focal plane shutter sequence is shown in Table 1-3, and the leaf shutter speed sequence in Table 1-4. See a shutter speed scale for a focal plane shutter in Figure 1-9, and for a leaf shutter lens in Figure 1-10.

B	1	2	4	8	15	30	60	125	250	500	1000	2000

Table 1-3. A focal plane shutter speed sequence

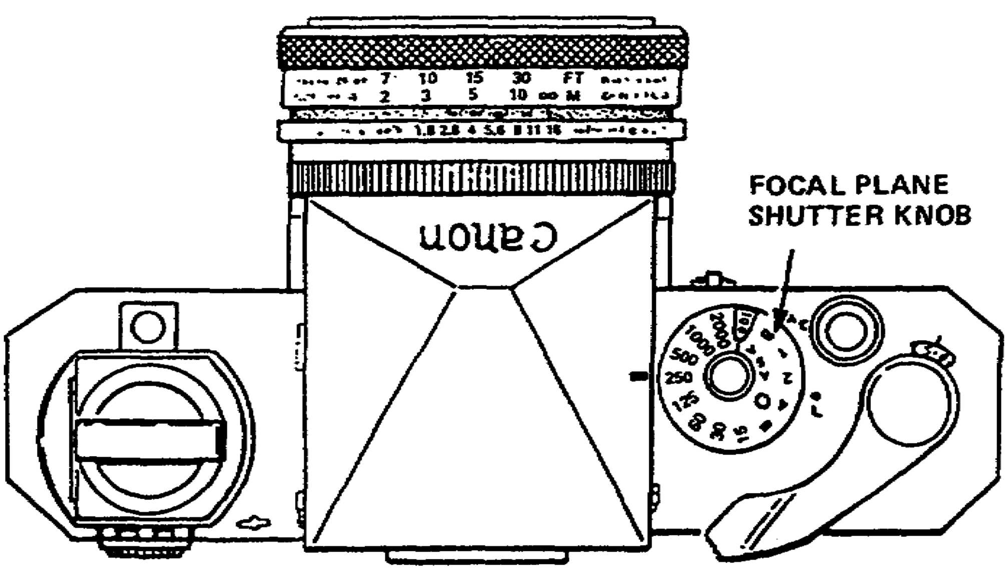


Figure 1-9. Top of a 35 mm camera showing the shutter speed scale for a focal plane shutter

T	B	1	2	5	10	25	50	100	200	400

Table 4-1. A leaf shutter speed sequence

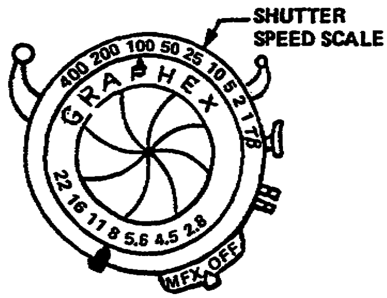


Figure 1-10. Front of a leaf shutter lens showing shutter speed scale

(These numbers represent fractions of a second. When you see 250, read 1/250, etc.)

a. As you can see, neither shutter sequence exactly changes the times by two; they only approximate. The true sequence would be as in Table 1-5.

1	1/2	1/4	1/8	1/16	1/32	1/64	1/128	1/256	1/512	1/1024

Table 1-5. A theoretically perfect shutter speed sequence

The reason for this is that to divide the shutter times exactly would require a very complicated set of gears. Also, as with the f/numbers, such precision isn't really necessary.

b. The time "T", and bulb "B" settings are for shutter speeds longer than one second. When the shutter is set to "T", two actions are required: the shutter release is tripped once to open the shutter, then tripped again to close it. This setting is usually found only on leaf-type shutters. The "B" setting is a little different. Pressing the shutter release opens the lens, and the lens stays open only so long as pressure is maintained on the release. Letting go will cause the lens to close immediately. This setting is almost always operated by using a cable release - a long flexible cord which attaches to the shutter release and has a plunger which trips the shutter (fig 1-11).

This prevents unwanted vibrations which occur when you hold the camera. Some cable releases have a locking device which will let you make a long exposure without having to stand there with your thumb on the plunger the whole time.

c. Mechanical shutters, whether leaf or focal plane type, can't be set to an intermediate speed for the same reason you can't select a gear between second and third while driving a car. For example, there is no way to select a 1/245 second or a 1/320 second shutter speed. This isn't really much of a problem, because lenses can be set to intermediate f/ values. The big advantage of purely mechanical shutters is that they don't rely on electricity.

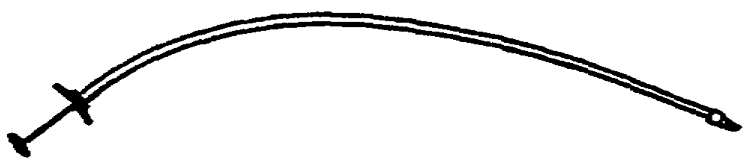


Figure 1-11. A cable release

d. Electronically-controlled shutters, which are made for both leaf and focal plane types, need a source of electricity. These shutters still rely on springs to make the larger parts move, but their timing is controlled electronically. This makes the mechanism smaller and lighter, because a lot of complicated timing gears are eliminated in favor of a very small computer chip. The shutter speed range is often extended to include full second exposure times of 2, 4, 8, and even longer.

(1) Electronic shutters can also operate at intermediate speeds, but usually only when the camera is operating in an "automatic" mode. They also have fewer moving parts, which make them less likely to break. On the negative side, though, these shutters use batteries, which can fail at unexpected times (usually the worst possible moment), and almost always in very cold weather.

(2) If your camera uses an electrically-controlled shutter, always carry a spare battery with you; and if you are planning to shoot in below-freezing conditions, try to find a camera with a completely mechanical shutter. Some camera makers do provide an accessory battery pack with a long wire attached. This allows you to keep the batteries in a warm inside pocket and still provide power to the camera. It's a bit cumbersome, but it works.

Learning Event 4:
DESCRIBE HOW TO DETERMINE EQUIVALENT EXPOSURES

1. Now to put some of this together. Remember what was said about equivalent exposure a few pages ago - how there could be any number of combinations of light intensity and time which would result in the same exposure? Well, now you have an easy way to compute as many equivalent exposures as you wish, and then to select the one which suits your purpose best. Let's put the two scales together as in Table 1-6.

SHUTTER SPEED:	1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250
F—NUMBER:	32	22	16	11	8	5.6	4	2.8	2

Table 1-6. Equivalent exposures

Notice that the two scales run in opposite directions. As you read from left to right, the shutter speeds progressively reduce exposure times in half, and the f/numbers progressively double the light intensities. Each of the above combinations of f/number and shutter speed provides exactly the same amount of exposure on the film. That is, an exposure of 1 second at f/32 will have the same darkening effect on the film as an exposure of 1/250 second at f/2, and so will all the others in between.

2. But what if this particular combination doesn't give the correct exposure? If you are in a dim room with a slow film, 1 second at f/32 probably won't be enough and the film will be underexposed. But perhaps an exposure of 1 second at f/5.6 would be enough to do the job. All you need to do is slide the two scales past each other until the f/5.6 is opposite the 1 second mark. Then all other shutter speed and f/number combinations will give the equivalent exposure. You can make an "Equivalent Exposure Calculator" by copying the two scales as they are shown here and then cutting the paper down the middle between them. Then you can actually slide the scales back and forth as described. The calculator, once you have found one good shutter and lens combination, will give you all the other equivalent exposure combinations available to you.

3. Another useful method is the "count on your fingers" method. This works well when you don't have your calculator handy. If you wish to change either the f/number or the shutter speed, you recite the number sequence while counting them on your fingers until you arrive at the number you want. Then you recite the other sequence exactly the same number of times to determine what your new value will be. That's quite a complicated explanation of a simple act. Here's an example. Suppose your camera is currently set at 1/500 second at f/5.6. You decide, however, that you'd rather shoot the picture at f/16. All you do is mentally count the f/number sequence up to f/16, "eight, eleven, sixteen". (Three stops, closing the lens.) Then count down in shutter speeds, "1/250, 1/125, 1/60"; also three stops, increasing the time. So your shutter speed at f/16 is 1/60 second. Just make sure that as you count up in f/numbers you count down in shutter speeds, and vice versa.

4. Earlier we said that mechanical shutters could not be set to an intermediate setting. With the iris diaphragm, you can select intermediate settings for the lens openings. It is with the iris diaphragm that you fine tune your exposures to the degree of precision you need. You will often see intermediate exposures written such as "1/2 second between f/16 and 22," or "1/2 sec @ f/16-22." You rarely ever see a precise intermediate value given for an f/number, such as "f/27". (There really is an f/27, of course. You just can't be that precise when setting a lens to intermediate positions.) The

only exception is when a manufacturer is describing the largest opening a lens has, in which case you might see expressions such as "f/1.7" or "f/4.5," to name two common maximum lens openings. These numbers are accurate because the lens parts are machined to that degree of precision when it is made. By the way, when f/numbers are used to describe the largest opening a lens can provide, the term is called the "lens speed," so if you see an expression such as "an f/1.4 lens," you know that the largest aperture the lens can be opened to is f/1.4.

5. So there you have it. Shutter speeds and f/stops are coordinated to give you a whole variety of choices when you actually make a photograph. There will be more about how to decide on a specific choice in Lesson 3.

Learning Event 5:
DESCRIBE THE USE OF A DAYLIGHT EXPOSURE TABLE

1. We've talked a lot about how to control exposure by changing f/stops and shutter speeds, and we've talked a lot about equivalent exposures, but how do you find a correct exposure in the first place? Now you are going to learn just that. First you have to understand something about film. Film isn't just film. It comes in various speeds, and before you try to determine an exposure, you first need to know the film speed. "Speed" is just photographer's jargon for a film emulsion's sensitivity to light. It is determined by a complex and careful procedure established by the International Standards Organization (ISO). Every film manufacturer in the free world rates film using the numbering system established by the ISO.

a. The system is set up so that as the speed numbers double, the film sensitivity also is doubled. For example, ISO 400 film is four times as sensitive to light as ISO 100 film. (How many stops is this?) Here's another example: If you are shooting ISO 125 film and switch to ISO 64 film, how would you adjust your exposure? (Right, you go on as before, but you open the lens exactly one stop.) That's why ISO 400 film is "one stop faster" than ISO 200 film.

b. The ISO system also gives you a really handy way of figuring out outdoor exposures without using a light meter. Look at Table 1-7. You use this table by first setting your shutter to 1 over the ISO number. That is, if your film is ISO 125, start with 1/125 second. If the ISO is 64, use the closest speed you have, i.e., 1/60 second.

2. Now that you have your shutter speed, you need to determine how bright your subject is. That's the vertical column at the left side of the table. Here is a breakdown of what those subject brightness labels mean.

a. Average subject. An average subject is one that reflects about 18 percent of the light striking it and absorbs the rest. This category includes people in medium-colored clothing, most buildings, landscapes with trees, and street scenes. The majority of photographic subjects are of average brightness.

b. Dark subject. A dark subject reflects only about 9 percent of the light striking it and absorbs the remainder. Because it is only half as bright as an average subject, it needs twice the exposure. Military tactical vehicles, weapons, people in dark-toned clothing, animals with dark fur, and very dark or black-looking stone are all dark subjects.

c. Bright subject. A bright subject reflects about twice as much light as an average subject. Consequently, it absorbs a much smaller percentage of light. A bright subject requires less exposure than an average subject - generally one stop less. Typical subjects in this category are fair-skinned and light-haired persons, people in light clothing, animals with white fur coats, and light-colored buildings.

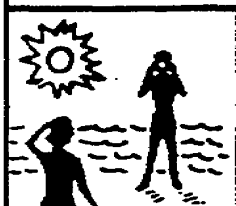
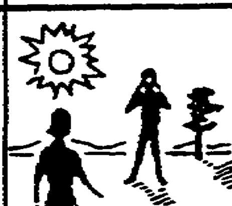
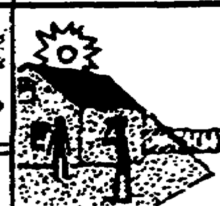
DAYLIGHT EXPOSURE TABLE USE SHUTTER SPEED WHICH IS RECIPROCAL OF FILM SPEED				
BRIGHT SUN ON LIGHT SAND OR SNOW	BRIGHT SUN SUBJECT IN DIRECT SUNLIGHT	HAZY SUN SOFT SHADOWS	CLOUDY BRIGHT WITH NO SHADOWS	OPEN SHADE WITH CLEAR BLUE SKY
				
BRILLIANT SUBJECT BETWEEN f/32 – f/45	f/32	f/22	f/16	f/11
BRIGHT SUBJECT BETWEEN f/22 – f/32	f/22	f/16	f/11	f/8
AVERAGE SUBJECT BETWEEN f/16 – f/22	f/16	f/11	f/8	f/5.6
DARK SUBJECT BETWEEN f/11 – f/16	f/11	f/8	f/5.6	f/4

Table 1-7. Estimating exposure outdoors

d. Brilliant subject. A brilliant subject reflects about four times as much light as an average subject and absorbs relatively little light. A brilliant subject requires much less exposure than an average one - generally two lens stops less. Snow-covered landscapes, people in white clothing on a white sand beach, a white sailboat against a blue sky, and white painted buildings are all brilliant.

3. Now you have shutter speed and subject brightness. Look at the horizontal row at the top of Table 1-7. There are five classes of illumination: bright sun on light sand or snow, bright sun, hazy sun, cloudy bright, and open shade.

a. Bright sun. This one is self-explanatory. The sky is clear, and the sun is far too bright to look at directly. Shadows are sharply defined, with a hard edge. This type of light is excellent for landscapes, architectural subjects, and anything else for which you want hard, clear definition. Because of the hardness, it is not usually a good type of light for portraits unless a hard effect is what you are looking for. Sometimes the contrast between the sunlight and shadow is so great that shadows look black and featureless, because the brightness range is so great the film cannot record it all.

b. Bright sun on light sand or snow. Because they act as reflectors, light sand or snow increases the amount of light on a subject about a half-stop more than under normal conditions. Otherwise, all the conditions but one described for bright sun apply. The one exception is contrast, which is usually fairly low because the reflections from the sand or snow casts light into the shadow areas, filling them in.

c. Hazy sun. On a hazy day, the sun is partially obscured by haze or thin high clouds, but the sun's disc is still clearly visible and bright. Shadows are still easy to see, but they are slightly diffused or soft and not as clearly defined as in bright sun. Because of the haze, distant scenes may be obscured. This can often be used to good effect. Hazy sun is often good for portraits of people whom you wish to portray as rugged. The shadows are clear enough to bring out skin texture and facial lines, but are often soft enough so that the shaded areas of the picture still show some detail.

d. Cloudy bright. On a cloudy bright day, the sun's disc is still visible, but barely so, because clouds almost hide it. To the eye, the day may seem very bright, but this lighting needs about two stops more exposure than bright sun. This lighting still produces visible shadows, but they are weak and have very soft edges. Cloudy bright conditions are excellent for general portraiture and scenes of short or middle distances. Distant scenes which include a lot of sky can be a problem because the sky, which is still very bright, will often be overexposed and will come out in a print as a featureless white. If you make prints with white, unexposed borders, it is often impossible to tell where the sky ends and the borders begin - they are both pure white.

e. Open shade. On cloudy dull days, the sun can't be located in the sky because it is entirely obscured by clouds. There are no shadows at all, except very faint ones under automobiles or picnic tables. The lighting is extremely soft and is good for portraits of children, women, or any other subjects you wish to show as softly as you can. Sometimes the light is too soft, and subjects appear flat because there are no shadows to give the viewer a feeling of depth. That's why this kind of light is often referred to as "flat". Open shade looks much like cloudy dull conditions, except that it can be found on a clear sunny day. Open shade is shade which is open to a lot of sky, but shaded from the direct rays of the sun. The shady side of a building is an excellent example. But there must be overhead skylight. Shade under a low, densely leafed tree or an awning is not "open". Cloudy dull and open shade need three stops more light than bright sun does.

f. The daylight exposure table helps you determine what setting to use outdoors. Once you have decided what the subject's brightness is and what type of lighting there is, you set the aperture to the setting where the rows and columns intersect (Table 1-7).

4. One final adjustment might need to be made. If the subject is fully lit by the sun behind you, you're all set; use the exposure exactly as it comes from the table. This is called front lighting. But if the sun is to one side shining across the subject so that part of it is lit by the direct rays of the sun and the rest by the light of the sky, you should open your lens one stop from the table's recommendation so that the shadows still show some detail; this is side lighting. If the sun is behind your subject and shining in your face, then you should give two stops more than the table indicates. This is called back lighting. Of course, if the lighting conditions are cloudy dull or cloudy bright, the shadows are so weak you don't have to worry about making these corrections; they are necessary only in bright or hazy sun.

a. You don't have to memorize Table 1-7, but it would help. What you must remember is what the subject and lighting conditions described above mean; then, think of the "sunny f/16 rule". That is, in bright sun with an average subject, use a basic exposure of 1/ISO at f/16. Then make adjustments based on the subject brightness and lighting conditions you are actually photographing.

b. One final caution about using this table. It only works outdoors, and then only two hours after sunrise until two hours before sunset. Beyond these times, the lighting conditions can vary widely and the table is almost useless.

Learning Event 6:
DESCRIBE HOW TO USE A LIGHT METER

1. What about the times and places where the daylight table doesn't work? How do you find the exposure then? For the first hundred years of photography's existence, the answer was, "Guess". There were a lot of hints for making a good guess, but for the most part, experience and judgement were the only way. Today there is a much better way to find an exposure and that's with a photoelectric light meter.

2. Sometimes these devices are called "exposure meters," but that's a somewhat misleading term. The simple fact is, that no matter how sophisticated they are, they really only measure the amount of light falling on a light-sensitive element. The calculator translates this to a reading of exposure. Keep in mind that this is only suggested exposure. You must still use some judgement, but if you do you will seldom get truly bad results using a meter. For the word "judgement' you could substitute "guess," but at least with a

light meter, the guessing is easier and more accurate, because you have a good place to start.

3. Before discussing how to interpret a light meter reading, let's first talk a little about how light meters work. There are two basic types, photovoltaic and photoresistant.

a. Photovoltaic meters use a selenium cell, which converts light energy directly into an electric current. (It's the same kind of cell used to power solar calculators.) The current is used to make a needle move. The brighter the light, the stronger the current, and the stronger the current, the farther the needle moves. This is an extremely straightforward way of measuring light. Its chief advantage is that it needs no batteries, because the electric current is generated by the very same light the meter is measuring. So this type of meter can be used anywhere, anytime; almost. Photovoltaic cells are not very efficient at converting light into electricity. In dim light, there just isn't sufficient current to move the needle enough to make an accurate measurement. This can be compensated for by making the selenium cell larger, but after a while it all becomes much too big to be practical. So selenium cell meters work only in relatively bright lighting situations. Even so, average room light or office light is usually enough to get a reliable reading with a good quality hand-held meter of this type.

b. Photoresistant meters, on the other hand, use a source of electricity to start with - usually a small battery. The light-sensitive element doesn't generate any electricity. Instead, it resists the electric current from the battery. As the light falling on the element becomes brighter, the resistance drops, the battery's current flows more and more easily, and the indicator needle moves farther and farther. This has several advantages. First, the cell's size is much less important. A very tiny cell works just as well as a large one. Second, this method is very, very sensitive. Extremely low light levels can be accurately measured. This has been put to good use inside many sophisticated camera, where the cell can read the tiny portion of light that is reflected off the surface of the film emulsion during exposure. In hand-held meters, indicated readings of up to 30 minutes are sometimes offered. Of course, if the battery goes dead, the meter is useless. And, just as with camera batteries, light meter batteries go dead at the worst possible times and always when they get cold. For most uses, the photoresistant type meter is preferred. But in extremely cold weather or when batteries are scarce or unavailable, the selenium cell meter still has its uses (fig 1-12).

4. Once the needle has settled down, we need a way to read exactly how far it has gone. In most cases, there is a simple scale, usually numbered, painted on the background behind the needle. You read the number the needle is pointing to and transfer it to a calculator dial to get an indicated exposure. In other meters, the needle is directly connected to the calculator dial. Turning the dial causes the needle to move to the left or right until the needle matches a mark on the background behind it. This is convenient because when the needle has been set on the index marked "nulled", the exposure indication is already set on the calculator dial, and needs only to be read. Some sophisticated and expensive light meters have done away with the calculator

dial entirely and show a suggested exposure with light-emitting diode (LED) or liquid crystal displays like those found on digital watches.

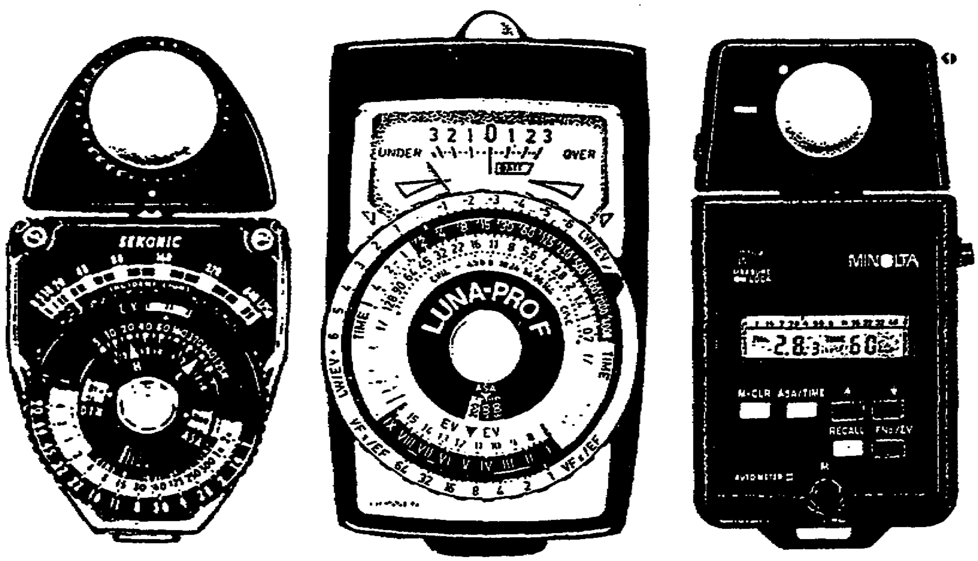


Figure 1-12. Three types of light meters

5. Take a look at the calculator dial shown in Figure 1-13. Once again, this is something that looks complicated, but really isn't. First of all, there's a little window, marked "ASA". ASA is just an obsolete abbreviation for what we now call the International Standards Organization (ISO), and it is, naturally, the same film speed we talked about earlier in this chapter. Notice that only some of the film speeds are actually numbered. Others are simply indicated by tick marks (fig 1-13). This is what a complete film speed scale looks like, and what those little tick marks represent. By turning the innermost dial, you can set any ISO number you wish, and this adjusts the rest of the dial scales to match. This is the most precise scale available on the meter; each tick mark represents a 1/3-stop change in the meter settings. All the other scale markings are 1/2-stop or more apart. The outermost scale is a reproduction of the scale behind the indicator needle, and next to it is an indent mark, in this case, a large arrow. This arrow is set to the same number the meter's needle moved to when the reading was taken. The most important scale should look familiar to you by now. Remember the section on equivalent exposures and how to construct an equivalent exposure calculator? Well, that's all this is. When you set the index mark to the number the meter needle fell on when the reading was taken, you slid the f/stop scale along the shutter speed scale as you did this. So now you simply choose one of the equivalent exposure settings which match the dial and shoot your picture.

6. You probably suspect that this isn't the whole story. First of all, you need to know how to use the meter to take a light reading in the first place, and second, you need to know how to interpret what the reading really means. Let's talk about taking readings first.

a. There are two systems for taking light readings: incident and reflected.

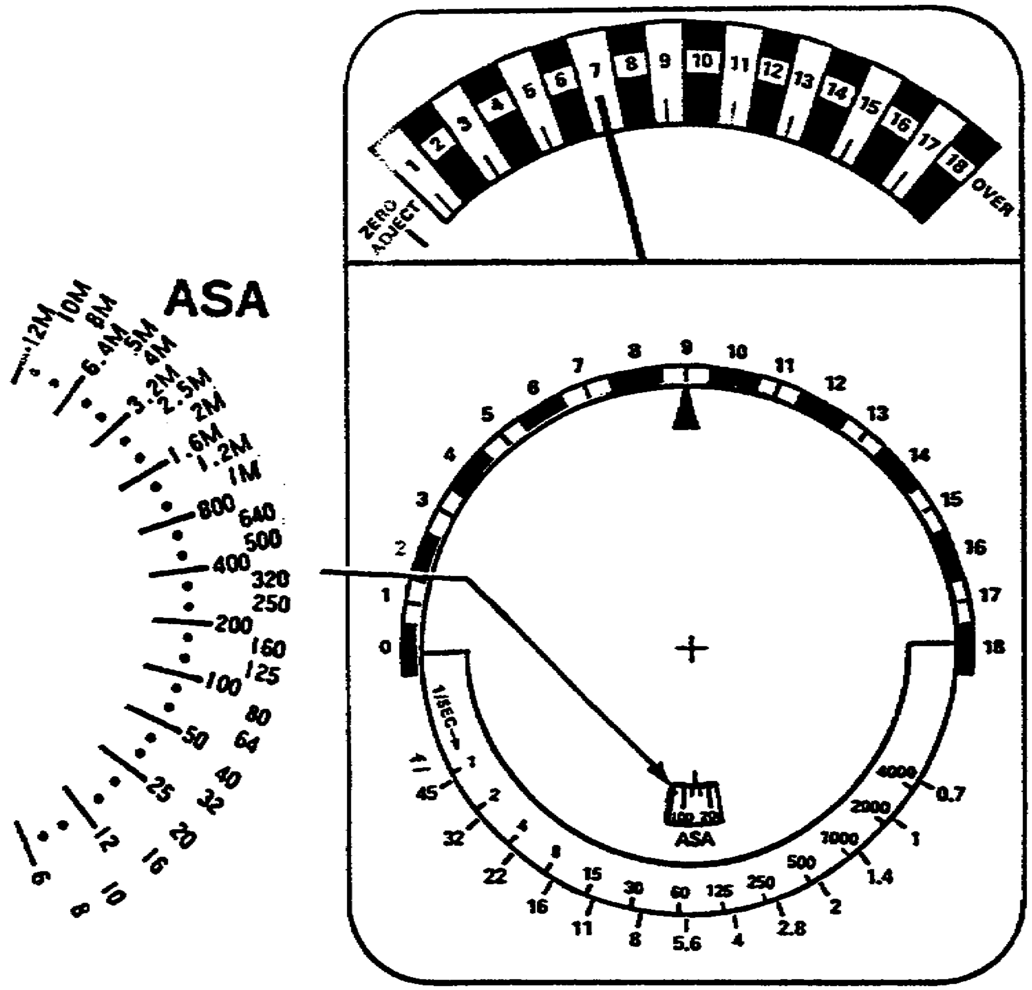


Figure 1-13. Calculator dial of a typical light meter

(1) Incident light readings measure the amount of light falling on the subject. They take no account of the subjects or tonality. An incident reading for a black cat would be exactly the same as a reading for a white house. The only thing that matters is the amount of light falling on the subject and to some extent its direction. It's easy to recognize an incident meter, because it has a hemispherical cover of translucent plastic (or dome) over the light sensor. In some meters, the dome looks exactly like a ping pong ball that has been sliced in half and glued over the element. The dome (called a "photosphere") collects the light and diffuses it toward the inside, causing a response from the sensor.

(2) To take an incident reading, place the dome in the same relation to the light as the subject you are photographing. Hold the meter near your subject and point the meter's dome toward the camera. The meter's dome is similar to a three-dimensional subject, and you are lighting it the same way. If the sun is high, then most of the light is falling on the top of the dome and the bottom is in shadow, just as your subject is. If your subject is backlit, then the meter's dome should be backlit the same way. Once again: Hold the meter near the subject and point the dome toward the camera lens. That's all there is to it. Read where the needle is, set the calculator dial, select a shutter and lens combination, and take your picture. This is the most reliable method of getting an exposure.

(3) There are a couple of other advantages as well. For example, you don't have to hold the meter close to your subject as long as it's in the same light as your subject. Thus on a sunny day, you only need to hold the meter in the same sunlight and make the light fall on it the same way as on the subject, and you'll get a good reading (fig 1-14).

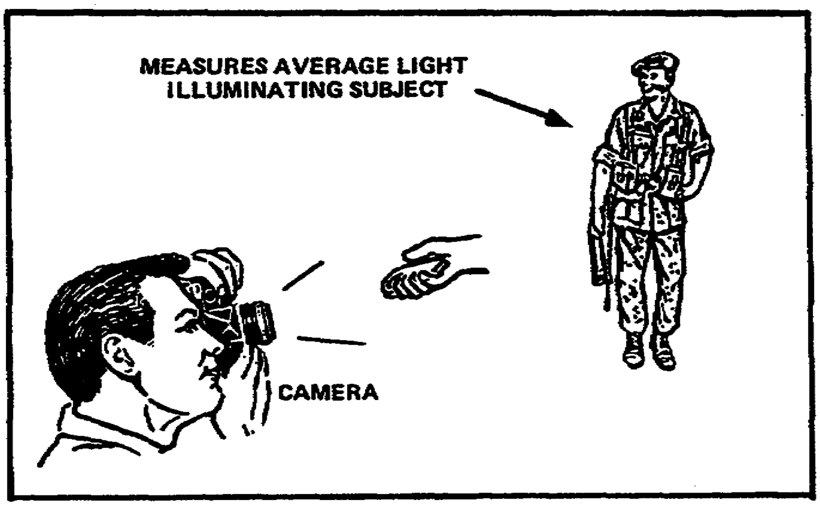


Figure 1-14. Incident light reading technique

b. Reflected light readings are almost the opposite of incident readings. In this case, you are reading the light coming from the subject and entering your camera lens. This is the same method, in principle, that cameras with built-in meters use. To take a reflected reading, you point the light meter toward the subject. There is no dome in front of the light sensor, so the light reflected by the subject is what makes the needle move. Now for many subjects, this will give an accurate enough reading, because the great majority of photographic subjects are "average"; that is, they contain a whole range of brightnesses from very dark to very light which, if all scrambled together, would be a middle tone of gray. Look back at the description of an average subject in Learning Event 5, paragraph 4a.

c. If the subject is one that doesn't average out to a middle gray, then you've got to use judgement. To understand why, you need to know one thing about the intelligence of light meters; they haven't the slightest idea what you are taking a picture of. In fact, light meters don't have the slightest idea what a picture is. All they do is react to light, and the calculator dial is designed to generate an exposure setting that will cause the film, on average, to be 18 percent gray. If you point the meter at a black cat, it doesn't know there is a black cat present - it just tells you what camera settings will make it gray. If you want your black cat to look gray, then OK. Just remember that if you do this, then everything that is lighter in tone than the black cat will be a lighter shade of gray or, eventually, pure white. The same is true of a white house. The meter reads the bright white house in sunshine and tells you what your camera setting should be to make it look 18 percent gray. Once again, if that's what you want, fine. But usually it isn't, so you must make adjustments, and that's where the experience comes in.

d. Since you now know how the meter makes everything gray, then you must decide how much lighter or darker you want your subject to really look, and instead of following what the meter says, adjust the exposure. For example, a white house generally is about five times as bright as the gray a meter wants to make it, so you would open your camera lens (or adjust your shutter, or a combination of both) to give slightly over two stops more exposure than the meter says you should. And that black cat is really about three stops darker than the gray the meter would make it, so you should adjust your actual exposure setting to give about three stops less than what the dial tells you (fig 1-15). You can take advantage of this in other ways, too.

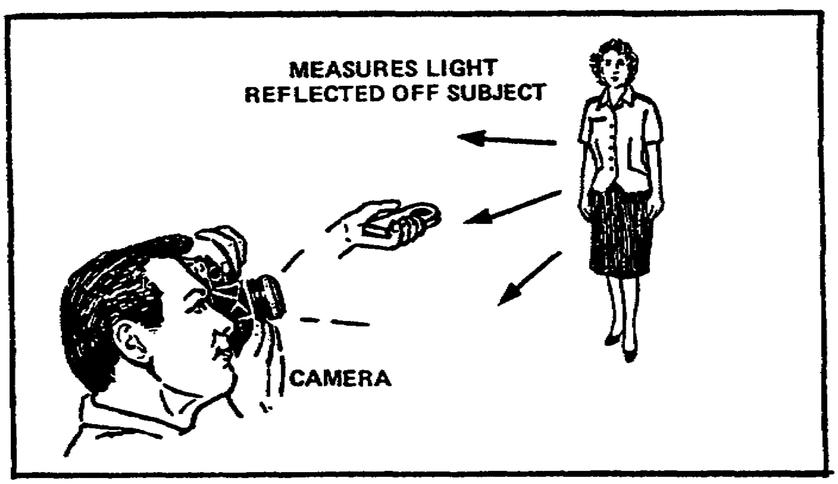


Figure 1-15. Reflected light reading technique

e. Kodak and other companies make a gray card which reflects 18 percent of the light striking it, which is an average middle gray. If you are trying to take a picture of a very light or very dark scene that is not average, place the gray card in the scene and take a close-up reflected meter reading of it. Then you can use this exposure to make your picture. Since the card is midway between black and white, all the other shades will be reproduced in the print.

(1) Even if you don't have a gray card, try to find something in the scene which you know should be about the same shade as a gray card. Take a close-up reading of that one small part of the scene and use the result to set your camera.

(2) Another way to determine a light reading is to use the palm of your hand as a starting point. The average palm skin tone is about one stop lighter than a gray card, so in a pinch, you can just place your hand in the same lighting as the scene you are photographing and meter it as you would a gray card. Then set your camera to give one stop more exposure than the meter says and you're set. If you take a comparison reading of a gray card and the palm of your hand (and remember what the difference is) you can adapt the technique for your own use.

(3) To carry this a step further, white houses are about five times as bright as middle gray. In fact, almost anything painted white or whitewashed is about 2-1/3 stops brighter than middle gray. So if you meter a white painted wall and then give 2-1/3 stops more than the meter indicates, then you will be pretty close to the right exposure. Most gray cards are gray on one side and white on the other. This white side is exactly five times as bright as the gray side. You can get a very good exposure by metering the white side of the card and giving five times the exposure the meter says. You can do this by opening the lens about 2-1/3 stops, or by adjusting the ISO setting on the meter to 1/5 what you would use with a gray card. This is particularly useful when taking a meter reading in dim scenes when there isn't enough light to make a meter's needle move. By using a white card, you can effectively extend the meter's usable range by a factor of five.

f. You must take care, when metering small areas, to hold the meter close enough to the area so that you are reading only the portion of the scene you want. If you include areas that are lighter or darker than the spot you wish to read, you'll get incorrect readings. Also, be careful about shading the meter's target with your body, your hand, or the meter itself.

7. Cameras with built-in meters are highly sophisticated, but they are still basically reflected light meters, and are susceptible to the same failings hand-held meters are. Many through-the-lens meters are center weighted, which means the meter pays more attention to the brightness in the center of the scene than to its edges. This is useful in certain lighting conditions, but doesn't do much good if you are trying to meter a darker or lighter than average scene which you don't want to look middle gray. Even the most sophisticated camera meter will try to make a white house or black cat the same shade of gray, just as the hand-held meter will. But the camera meter can be manipulated the same way a hand-held meter can, and all the tips in this lesson can be used with your camera just as effectively as well. Of course, once you know how to use a calculator dial, you might find it so useful you may regret that cameras with built-in meters don't have one.

8. Ansel Adams, one of the great nature photographers, made an entire career of writing about how to make adjustments to reflected exposure readings. In the hands of an expert, reflected light readings can give absolutely beautiful exposures. But most of the time, you can get just as good an exposure by taking an incident reading and using exactly what the dial tells you. Incident readings aren't perfect, and in really unusual conditions such as very dark or very bright subjects or unusual lighting conditions you might not get a great exposure without making an adjustment or two. In general, however, the beginning photographer will find that incident readings are much more reliable than reflected ones.

9. Most important is learning not to be a slave to those ISO numbers. If you use a light meter correctly and get consistently overexposed or underexposed negatives (and the key word here is consistently), then adjust the film speed setting accordingly. If your negatives are always denser than you like them, then instead of using the manufacturer's ISO setting, use double that number and try another roll of film. Once you find an ISO setting that consistently gives you good results, then stick with it. There are all sorts of reasons you may have to do this; your camera shutter may be a little faster or slower than marked, the lens apertures may not be accurate, your metering technique may not be quite the same as that recommended by the manufacturer, the processing chemistry might be different, and so on. Don't be afraid to experiment if you don't like the results when you follow the book. Of course, if you aren't getting consistent results - some negatives overexposed, some under, others OK - then you need to examine your own techniques to find out what is wrong. It may be that you are unconsciously using a bad technique, or that your equipment is malfunctioning.

10. Care of the equipment. While this part is specifically about light meters, many of these requirements apply to <u>all</u> photo equipment.

a. Read the instructions. This is so simple, yet so overlooked, that it almost seems insulting to mention it. But many times a piece of equipment is damaged just because the user thought he knew what he was doing and was sadly mistaken. Most instruction books thoroughly cover the care requirements for a piece of equipment and often also offer a good troubleshooting guide to help you find out what is wrong when something just doesn't seem to work. They deserve your close attention.

b. Protect the meter from shocks. A meter which uses a needle movement is as delicate as a watch. A sharp blow will knock the mechanism off its bearings so it will not work smoothly. It's a good habit to check your meter frequently (at least before each day's use) by covering and uncovering the sensor with your hand and watching the movement of the needle. If it swings smoothly, then it's all right. But if it sticks even slightly, it could be damaged and should be turned in for repair. Also, check the zero setting. To do this, cover the sensor completely with you hand, being careful to block out all the light. The needle should come to rest on a zero mark on the background scale. If it doesn't, there is usually a small screw on the back which will adjust the needle so that it does. Otherwise, the meter will give incorrect readings.

c. Keep the meter away from extreme heat. If it is heated above 120 degrees Fahrenheit for any appreciable length of time, the meter could be severely damaged. In particular, a glove compartment on a warm sunny day can ruin camera gear.

d. Keep the meter away from moisture. Water can short out the wiring, and can also cause metal parts to corrode, affecting the smooth operation of the mechanism. If you must use the meter in wet weather, seal it inside a clear plastic bag.

e. Never point the sensor directly at the sun or any extremely bright light source; this can easily damage it. In some cases, the damage isn't permanent, and the sensor is only "blinded" for a while and will recover after a few minutes or hours. Until it does, though, it won't be reliable. In severe cases, the damage can be permanent.

f. If you don't plan to use the meter for an extended period of time (two weeks is a common recommendation), remove the battery. The battery case could rupture and acid could leak out.

11. Summary of lesson. By now you should know the theory of exposure, what f/numbers are, how shutter speeds work to control exposure, how to find equivalent exposures, how to get a usable exposure using the daylight exposure table, and how to use a light meter. To find out how much you've learned, answer the questions that follow, then check in the back of this book to see how well you did.

Lesson 1
PRACTICE EXERCISE

1. When light strikes a piece of film, what is the term used for the undeveloped image?

a. Indelible image
b. Latent image
c. Incomplete image
d. Late image
e. Inclusive image

2. The exposure formula is written $E = I \times T$. What do the E, I, and T stand for?

a. Exposure, Index, and Time
b. Exposure, Intensity, and Time
c. Externity, Inherency, and Time
d. Extremity, Intensity, and Tendency
e. Current, Voltage, and Resistance

3. Complete this sentence: Two combinations of I and T which result in the same E are called___________.

a. Actual exposure
b. Acceptable exposure
c. Equal exposure
d. Equivalent exposure
e. Equitable exposure

4. The opening in the lens which light passes through is called the ______ _______________.

a. Pore
b. Actuality
c. Aperture
d. Operculum
e. Oculus

5. The device in the light path through a lens which controls the size of its opening is called the_________________ .

a. Diarhomb
b. Diatherm
c. Diaphage
d. Diaphragm
e. Diastygma

6. What does the "f" stand for in an f/number?

a. Focus
b. Factor number
c. Focal width
d. Focal point
e. Focal length

7. When changing from a small f/number to a larger one, what happens to the amount of light passing through the lens?

a. The amount decreases
b. The amount increases
c. There is no change
d. The change is minimal

8. When changing a lens' opening from f/32 to f/4, how much of an increase or decrease in brightness does this represent?

a. Increases 64 times
b. Increases 5 times
c. Decreases 64 times
d. Decreases 5 times
e. Increases 10 times

9. A four-stop change in a lens aperture changes the light by how much?

a. 4 times
b. 8 times
c. 16 times
d. 20 times
e. 32 times

10. (True or false) It is possible to change the aperture settings on a lens by amounts less than full stops?

a. True
b. False

11. (True or false) It is possible to change shutter speeds by less than the amounts marked on the control dial?

a. True
b. False

12. What are the two basic types of camera shutters currently in use in most common cameras?

a. Optical and physical
b. Leaf and blade
c. Leaf and focal plane
d. Waterhouse and focal plane
e. Optical and mechanical

13. How much more light passes through a lens at 1/15 second than at 1/500? How much is this in f/stops?

a. 64 times, 5 stops
b. 32 times, 5 stops
c. 32 times, 6 stops
d. 16 times, 4 stops
e. 16 times, 5 stops

For questions 14 and 15 use an initial exposure setting of 1/30 second at f/45.

14. What shutter speed is equivalent to the initial exposure setting if the f/stop is changed to f/11? f/4? f/64?

a. 1/500, 1/2000, 1/15
b. 1/250, 1/4000, 1/8
c. 1/500, 1/1000, 1/15
d. 1/500, 1/4000, 1/15
e. 1/500, 1/4000, 1/60

15. What f/number is equivalent to the initial exposure if the shutter speed is changed to 1/2 second? 1/500 second? 1/8 second?

a. f/180, f/11, f/90
b. f/90, f/5.6, f/64
c. f/128, f/11, f/64
d. f/256, f/16, f/128
e. f/180, f/11, f/128

For questions 16 through 20 refer to the daylight exposure table, Table 1-7. Use the shutter speed sequence for focal plane shutters.

16. Using ISO 125 film in bright sun and shooting an average subject, what is the basic exposure?

a. 1/125 second at f/8
b. 1/125 second at f/11
c. 1/125 second at f/16
d. 1/125 second at f/32
e. 1/60 second at f/32

17. What is the basic exposure using ISO 125 film in bright sun, backlit with a bright subject?

a. 1/125 second at f/8
b. 1/125 second at f/11
c. 1/125 second at f/16
d. 1/125 second at f/32
e. 1/60 second at f/32

18. Using ISO 64 film in cloudy bright sun, side lit, dark subject, and an f/number of 4, what should the shutter speed be?

a. 1/60 second
b. 1/125 second
c. 1/250 second
d. 1/500 second
e. 1/1000 second

19. Using ISO 400 film in cloudy, dull lighting, brilliant subject, and a shutter speed of 1/250 second, what should the f/number be?

a. f/5.6
b. f/8
c. f/11
d. f/16
e. f/22

20. Using ISO 200 film in bright sun, backlit, dark subject, and an f/number of 5.6, what should the shutter speed be?

a. 1/30 second
b. 1/60 second
c. 1/125 second
d. 1/250 second
e. 1/500 second

21. What is the "sunny f/16 rule"?

a. ISO at f/16
b. ISO + 1 at f/16
c. ISO/1 at f/16
d. 1/ISO at f/16
e. ISO-1 at f/16

22. If a lens of 200 mm focal length has an opening of 36 mm diameter, what is the f/number?

a. 2.8
b. 4
c. 5.6
d. 8
e. 11

23. If a lens of 50 mm focal length is set at f/11, how large, in millimeters, is the diameter of the lens opening?

a. 4.55 mm
b. 4.02 mm
c. 4.97 mm
d. 3.76 mm
e. 5.03 mm

24. When and where does the daylight exposure table give reliable results?

a. Outdoors from sunrise to sunset
b. Outdoors from 1 hour before sunrise to 1 hour after sunset
c. Indoors or outdoors as long as the source is daylight
d. Outdoors from two hours after sunrise to 2 hours before sunset
e. Outdoors from two hours before sunrise to 2 hours after sunset

For questions 25 through 28 you will need to cut out and assemble the practice light meter printed on the inside back cover of this book. Save it. You will also need it to complete the final examination.

25. Set the film speed indicator on your practice meter to ISO 100. If the meter's needle pointed to 7 when you took a reading, what f/number should you use at 1/30 second?

a. f/2
b. f/4
c. f/5.6
d. f/8
e. f/11

26. With your meter set to ISO 400, you took an incident reading and the needle came to rest at 11 on the background scale. Which is the correct shutter speed to use at f/11?

a. 1/30 second
b. 1/60 second
c. 1/125 second
d. 1/250 second
e. 1/500 second

27. This time, the film speed is ISO 25. The needle rests on 13. Which of the following is the correct exposure setting?

a. 1/60 second at f/11
b. 1/125 second at f/16
c. 1/30 second at f/22
d. 1/500 second at f/2.8
e. 1/2 second at f/45

28. You must take a photograph in a dimly-lit room filed with mostly dark furniture. When you try to get an exposure with your meter, the needle doesn't move. You place a white card in the scene and take a reflected light reading of it. This time, the needle swings just past 2. With ISO 1600 film, which of the following is the correct exposure setting?

a. 1/60 second at f/1-1.4
b. 1 second at f/8-11
c. 1/4 second at f/2-2.8
d. 1/15 second at f/1.4-2
e. 1/2 second at f/4-5.6

LESSON 2
PHOTOGRAPHIC FILTERS

TASK

Describe the theory of photographic filters, their general construction, and their proper use in black-and-white photography.

CONDITIONS

Given information and diagrams pertaining to the theory, construction, selection, and use of photographic filters.

STANDARD

Demonstrate competency of the task skills and knowledge by correctly responding to a minimum of 80 percent of the multiple-choice test covering the theory of photographic filters, their general construction, and their proper use in black-and-white photography.

REFERENCES

TM 11-401-1

Learning Event 1:
DESCRIBE THE COLOR OF LIGHT

1. In Lesson 1, you learned about exposure. You focused carefully, held the camera steady, squeezed the shutter release, and took a perfect picture. So why isn't the print as great as the picture you saw in your mind's eye? The red apple in the green tree stood out clearly, but in the black and white picture, it looks almost the same shade of gray as the leaves. And that blue blouse and yellow dress the girl was wearing, both look gray; it's hard to tell which is which. And what happened to the landscape with those beautiful white clouds so sharp against a brilliant blue sky - the clouds are barely visible and the sky is a washed-out gray. What went wrong? More important, what can be done about it? By using appropriate filters with the right film emulsions, you can make corrections for the film's tendency to misrecord the scene you wanted.

2. Wavelengths of light. To understand filters, you must first understand a few basic things about light. Perhaps you learned in school that white light is made up of the colors of the rainbow - red, orange, yellow, green, blue, indigo, and violet (fig 2-1). You might have also learned that light travels in waves, somewhat like the expanding ripples created when you toss a rock into a quiet pool of water. One big difference between the two (among many) is the distance between crests of the waves. The distance between crests is called a wavelength. In water, the distance might be a foot or so. With light, however, the distance between crests of the waves is measured in billionths of a meter, called nanometers for short, and abbreviated still further

to nm. Visible light - that which most people can actually see - has wavelengths between 400 and 700 nm. Violet light has the shortest wavelength, followed by indigo, blue, green, yellow, orange, and finally red, which has the longest. But there's more. As the wavelength of light becomes even shorter than 400 nm, it seems, to your eye, to disappear. But all film still reacts to the energy of these extremely short wavelengths even more than to some wavelengths of visible light. This light, since it is even more energetic than violet, is called ultraviolet. A similar situation exists at the other end of the spectrum. As the wavelength of red light gets longer and longer, after it passes 700 nm, it, too, becomes invisible to your eye. But there are special films that can be made to react to this invisible energy called infrared (below red). Both of these light forms have importance in photography.

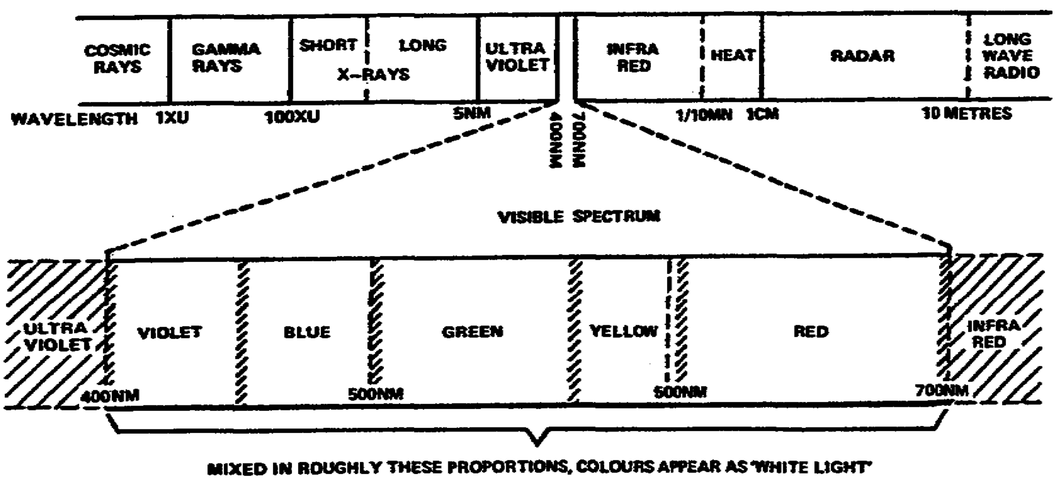


Figure 2-1. The visible spectrum

3. Now seven colors in the visible spectrum is really more complicated than necessary. In the early 1800's, even before photography was invented, a physicist discovered that by mixing only three colors, he could produce all the other colors of visible light. The three colors he found are red, green, and blue. In fact, these are the same three colors which are used in a color television picture. If you look very closely at a color TV picture, you'll see that it is composed of tiny dots of these three colors. By adding these colors together in different proportions, all the colors in the picture are reproduced.

4. These three colors - red, green, and blue, are called additive primary colors, because they add up to white. You can do this by using three slide projectors. Put a filter of a different primary color over the lens of each projector and aim the light beams at a white wall so that they overlap. When all three projectors are on at once, the result will be white light. Actually, the "white" might be a little off unless you are very careful to balance the intensities of the three projectors to exactly the right brightnesses, and the three filters are precisely the right color. But it will be close(fig 2-2).

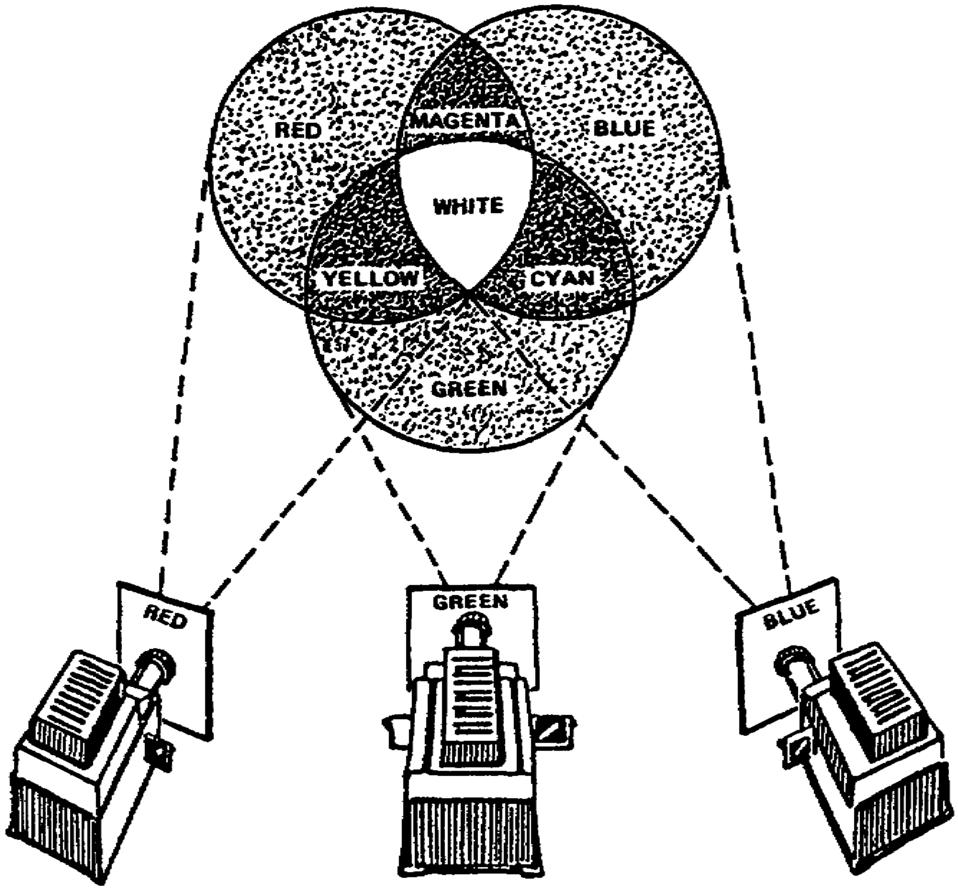


Figure 2-2. Additive primary colors
(You are looking at the colors being projected on a screen by three different projectors, each casting a single primary color.)

a. Now an interesting thing happens when you shut off one of the projectors, leaving only two primary colors shining on the wall. If you turn off the red projector, the resulting color will be a combination of green and blue called cyan, which looks like what is often called aquamarine or turquoise.

b. If you turn off the green projector, the resulting color is a combination of red and blue called magenta, a reddish purple shade.

c. Most surprising of all, if you turn off the blue projector, the resulting combination of red and green is yellow.

d. These three colors are called subtractive primary colors, also often called complementary colors (fig 2-3).

e. The relationship of additive and subtractive primary colors is shown in Figure 2-4. Notice that in this drawing, the color opposite each primary is the complement necessary to make white.

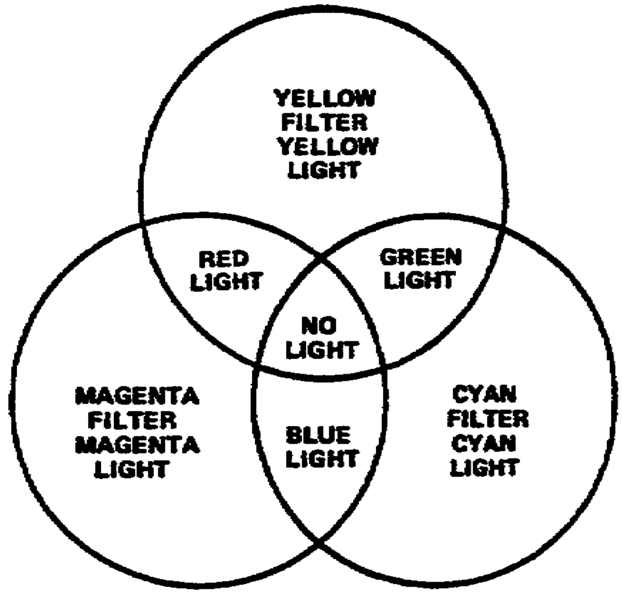


Figure 2-3. Subtractive primary colors
(You are looking through the overlapping filters at a white light source behind them.)

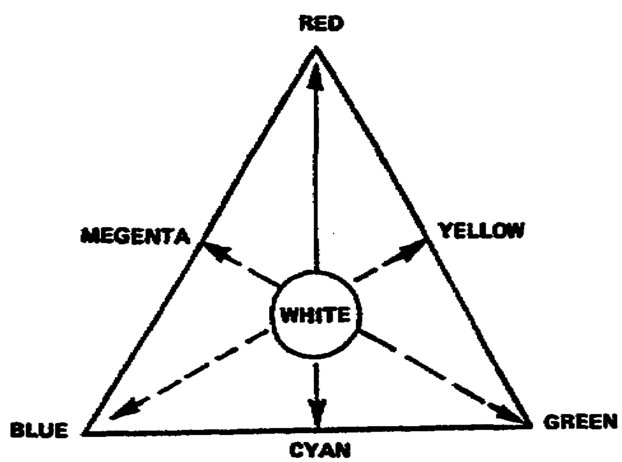


Figure 2-4. Complementary colors

5. You can think of these colors in two ways - either they are created by adding primary colors to build up to white, or you can think of them as being created by subtracting colors from white light. For instance, yellow can be thought of either as red added to green, or as blue subtracted from white.

Figure 2-5 might help make this a little clearer. In general, when using filters for black and white photography, thinking subtractively is more useful. This is because filters, without exception, subtract something from the light that is there in front of you; they never add to light. How could they, anyway?

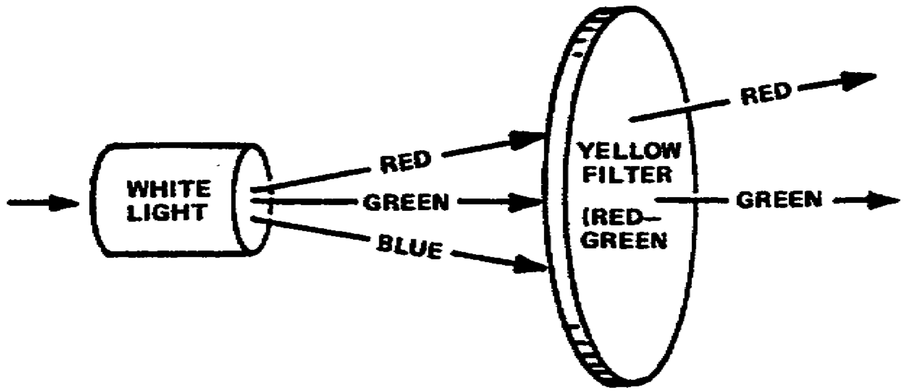


Figure 2-5. "Yellow light" can be thought of either as "Red plus green" or as "White minus blue"

Learning Event 2:
DESCRIBE THE COLOR SENSITIVITY OF FILM

1. Even though black and white film doesn't record color, it does react to it - but not the same way the human eye does. The wizards at the film manufacturers have been trying for a long time to make black and white film react in human fashion.

2. The very first photographic emulsions certainly didn't work like the eye; in fact, they responded only to ultraviolet and blue light. For this reason, they were called colorblind (also sometimes monochromatic) emulsions. It was almost 40 years before chemists discovered dyes that could be added to a film emulsion which extended its sensitivity range to include green light. They were so elated by this dramatic improvement that they called the film orthochromatic (correct color). This was an exaggeration, of course, because the emulsions were still blind to red light. It wasn't until the 1890's that further dyes were found which extended the emulsion's range to include the red portion of the spectrum. They couldn't call the new emulsion orthochromatic because that word was already taken, so they came up with panchromatic (all color). Most black and white films used in cameras today are panchromatic (called "pan" for short), but orthochromatic (ortho) and colorblind emulsions still have uses in portraiture and copy work, and especially in scientific, technical, and astronomical applications. They also are quite common in printing papers and motion picture print films. In fact, all three types of emulsions, in specialized form, are used in making color film (fig 2-6).

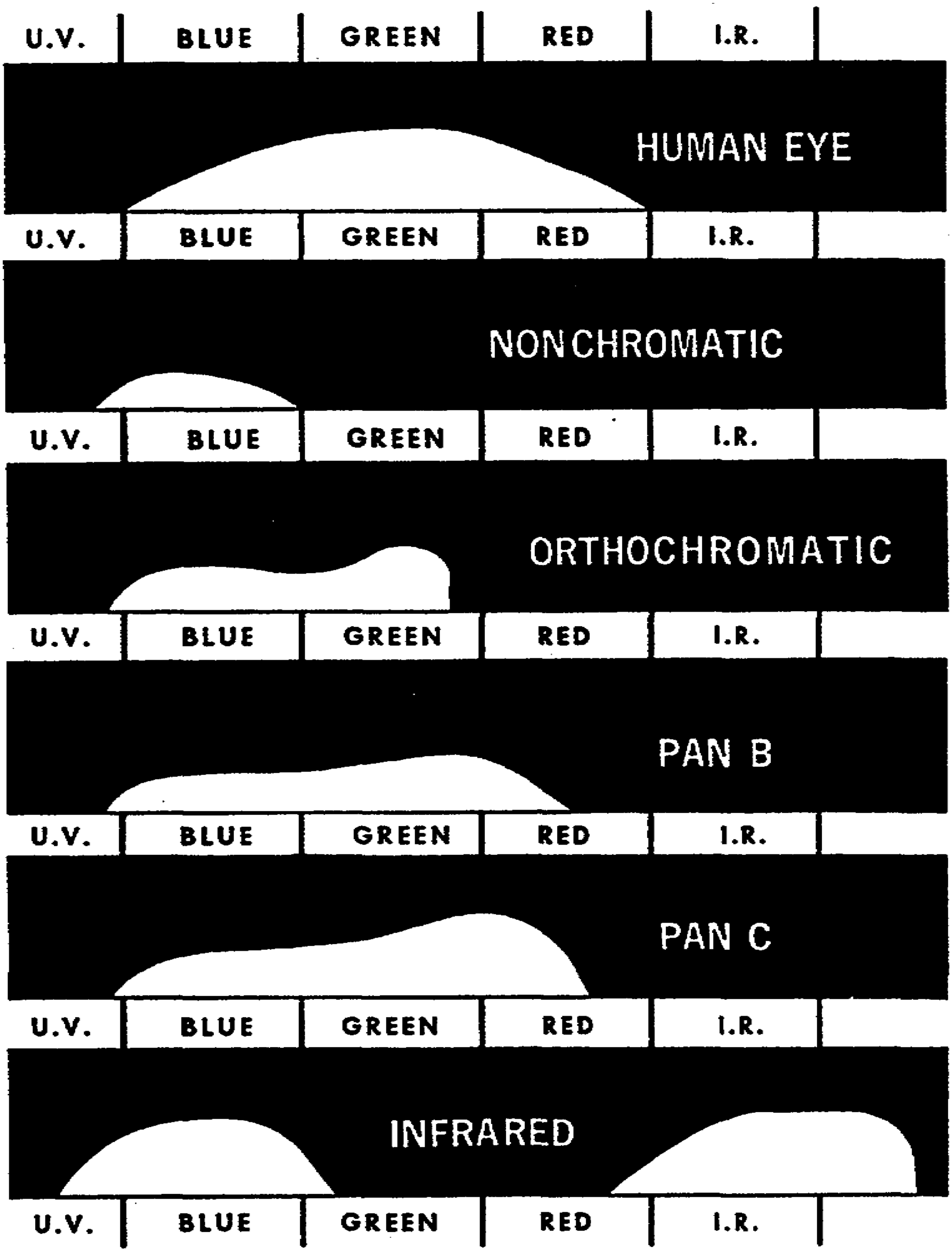


Figure 2-6. Sensitivity diagrams of the human eye

3. But even panchromatic film doesn't see the world the same way your eye does. First of all, the film is still sensitive to ultraviolet light, which is invisible to you. (And there's quite a lot of UV light around, especially in daylight.) Second, the film's relative sensitivity to different colors isn't the same as your eye's. For example, the human eye is most sensitive to green, but pan film is more sensitive to red. Look back at Figure 2-6 to see how the eye responds to light. Even if the film's relative sensitivity actually matched your eye's, there would still be a problem. You see a red apple against the green leaves of the tree, and you have no problem distinguishing between the two because you see their colors and they look very different. But pan film might see those particular shades of red and green almost equally and convert them into similar shades of gray; the apple is now much harder to pick out. If there were only a way to darken or lighten the apple without doing anything to the shade of the foliage, then the apple would again stand out as clearly in the black and white print, much as you saw it in real life. Fortunately, there is a way, and that's by using filters.

Learning Event 3:
DESCRIBE THE CONSTRUCTION AND EFFECTS OF FILTERS

1. A filter is nothing more than a device to block some of the color wavelengths while letting others pass unobstructed. They are commonly made of two types of materials, and each has its advantages and disadvantages.

2. Gelatin (gels) filters are just that; very thin sheets of a special type of gelatin to which dyes have been added to give them their color. They are very fragile, easily scratched, and almost impossible to clean once they have gotten dust or fingerprints on them. But they are cheap, so if you have a special need for a filter and don't expect to use it again, it could be a good economic move to buy a gelatin filter for one-time use and then throw it away when it wears out. Another advantage of gels is that they come in the widest selection of colors and densities. So again, if you have a special need, you may not be able to find the filter you want in anything other than gelatin.

3. Glass filters are really gelatin filters, but to make them more durable, the gel is sandwiched between two thin pieces of optical glass. These filters are more expensive, of course, but they are much more durable. If you plan to use the filter frequently for a long time, the extra expense of glass will pay off. They can be cleaned just like a lens and come mounted in metal rings so they can be easily attached and removed from the lens.

4. Another type of glass filter is solid glass which has been dyed to the desired color. These are extremely expensive because of the difficulty of coloring molten glass to precise color shades and densities. They are by far the most durable since they resist fading. Both gelatin and sandwiched glass filters will fade over time. The expense of solid glass filters limits their use to critical technical tasks and for calibration.

Learning Event 4:
EXPLAIN THE THEORY OF FILTERS

1. Now that you know what filters are made of, how do they work? Remember the red apple against the green foliage that looked so dull because both the apple and the leaves looked the same shade of gray? With filters, you can now have it either of two ways. If you want to make the apple look dark against relatively light leaves, try using a green filter. Leaves look green because they absorb a lot of the red and blue parts of the light, but reflect most of the green part. The green light passes right on through the filter, and the exposure of the leaves is hardly affected at all, because almost all the light reaches the film. But the apple, which looks red because it absorbs blue and green and reflects only the red part of the light striking it, has most of its light blocked. The film receives much less exposure from the apple and as a result it looks darker than the foliage, standing out clearly in the print. On the other hand, if you were to change to a red filter, the opposite effect would happen. The green leaves, reflecting very little red light, would be darkened considerably, while most of the red light passes through the filter to the film. The result would be a light apple against dark leaves.

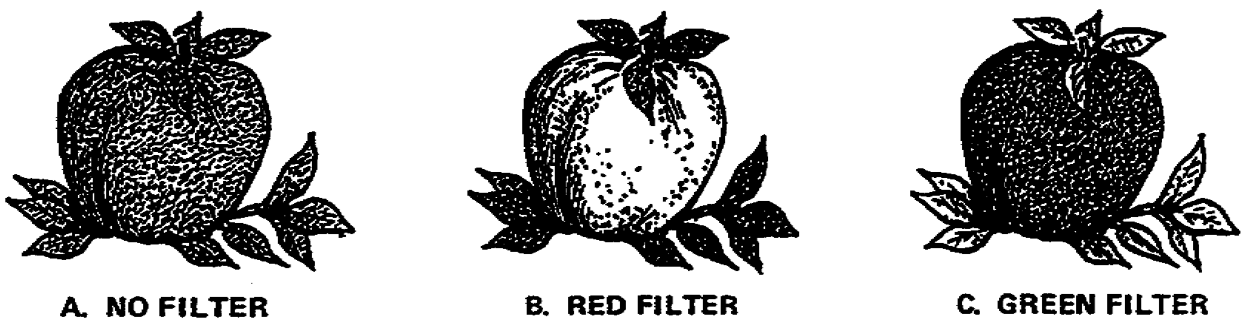


Figure 2-7. Red apple and green leaves

2. The girl is wearing a blue blouse and yellow dress; how would you handle a situation like that? Using a yellow filter will let most of the yellow light from her dress through to the film, making it look relatively light, while the blue light from the blouse will be stopped by the filter and appear darker than if no filter is used.

3. White clouds in a blue sky is a problem that has many solutions. If you were to use a yellow filter, the blue light from the sky will be blocked and the sky will be darkened. The white clouds will also be darkened but since they are white and have a lot of green and red light coming from them they won't be darkened as much. Now, a light yellow filter will block blue, but not entirely, and the effect will be somewhat modest. Using progressively stronger filters, each more efficient at cutting out blue light, will strengthen the effect. Finally, by using a red filter, the blue sky can be made very dark, while the white clouds stay white.

4. If you've read the last three paragraphs carefully, you might have already figured this out, but just to be sure, A FILTER PASSES ITS OWN COLOR AND BLOCKS ITS COMPLEMENTARY COLORS. This is the main thing to keep in mind when trying to predict what effect a filter will have on a scene.

5. But there is a problem here. If a filter takes away something even from white (and grays as well, because they are simply darker shades of white), what happens to the exposure? Won't it take more to compensate? Yes, it will, but the film manufacturers have already thought about this and will give you filter factors in the instructions for each type of film they sell. A filter factor is simply the amount you must multiply an exposure by to compensate for what the filter is absorbing. If the factor is 2, then you must give twice as much exposure; if it's 1-1/2, then you must give one and one-half times as much exposure as you would without the filter. This is about 2/3 of a stop. When you use a hand-held meter, you always figure your basic exposure first, then add the exposure needed for the filter. Of course if you want, you could adjust your meter by dividing the ISO speed by the filter factor and use the result to set your meter or as a starting point for the outdoor exposure table. Just don't forget to reset your meter when you remove the filter (Table 2-1).

FILTER FACTORS FOR KODAK BLACK—AND—WHITE FILMS *

FILTER NUMBER	COLOR OF FILTER	*VERICHROME PAN, PLUS-X PAN, PANATOMIC-X, AND TRI-X PAN FILMS*			
		DAYLIGHT		TUNGSTEN	
		FILTER FACTOR	OPEN THE LENS BY (f–STOPS)	FILTER FACTOR	OPEN THE LENS BY (f-STOPS)
3	LIGHT YELLOW	1.5	2/3	—	—
4	YELLOW	1.5	2/3	1.5	2/3
6 (K1)	LIGHT YELLOW	1.5	2/3	1.5	2/3
8 (K2)	YELLOW	2	1	1.5	2/3
9 (K3)	DEEP YELLOW	2	1	1.5	2/3
11 (X1)	YELLOW—GREEN	4	2	4	2
12	YELLOW	2	1	1.5	2/3
13 (X2)	DARK YELLOW—GREEN	5	2 1/3	4	2
15 (G)	DEEP YELLOW	2.5	1 1/3	1.5	2/3
23A	LIGHT RED	6	2 2/3	3	1 2/3
50	VERY DARK BLUE	20	4 1/3	40	5 1/3
25 (A)	RED	8	3	5	2 1/3
58 (B)	GREEN	6	2 2/3	6	2 2/3
47 (C5)	BLUE	6	2 2/3	12	3 2/3
29 (F)	DEEP RED	16	4	8	3
61 (N)	GREEN	12	3 2/3	12	3 2/3
47B	BLUE	8	3	16	4
POLARIZING SCREEN—GRAY		2.5	1 1/3	2.5	1 1/3

* THE FILTER FACTORS FOR A SPECIFIC FILM MAY VARY SOMEWHAT FROM THIS LISTING. SEE THE FILM INSTRUCTIONS.

Table 2-1. *Filter factors for a variety of Kodak film filter light source combinations
(Other manufacturers publish similar tables)

Learning Event 5:
IDENTIFY FILTERS FOR BLACK AND WHITE PHOTOGRAPHY

1. Now comes the real world. How are filters described? It's really a “bad news, good news" story. The bad news is that there is no standard description for the filters most commonly used with black and white film. Kodak has used two different methods, and other manufacturers use their own designations. The good news is it really doesn't matter. There are only about six common filter colors generally useful with black and white film: yellow, yellow-green, green, orange, red, and blue. Precise colors may vary slightly from manufacturer to manufacturer, but they are usually close enough not to be a problem. Just keep in mind that the most reliable filter factors are in the data sheet for the film, not the one that comes with the filter. Kodak uses Wratten numbers for describing various filters. Once you know that a no. 8 filter is yellow, you can use the filter factor for any similar yellow filter no matter what its manufacturer happens to call it.

2. Here are the most common filter colors used with black and white film, and some of their applications:

a. Yellow (Wratten no. 8, also called K2 or Y2). This is one of two filters designed to correct for a black and white emulsion's difference in sensitivity from the eye's. It reduces the excessive blue and ultraviolet light present in daylight, to which most films are overly sensitive. If you take a color picture that has blue sky and clouds, then a black and white picture of the same subject without a filter, and finally one with a no. 8 filter, the clouds rendered by the yellow filter should stand out against the sky about the same as they do in the color photo. The shot taken without the filter will show a nearly white sky with barely visible clouds. When shooting black and white outdoor scenes with pan film, especially those with blue sky, this filter is recommended at all times when you don't wish to use another filter.

b. Yellow-green (Wratten no. 11, also called X1 or YG1). This is the other correction filter. But where the no. 8 filter corrects an emulsion to daylight, the no. 11 corrects for the excessive redness of tungsten illumination. Any lamp which makes light by heating a wire filament produces tungsten illumination. Ordinary household bulbs and the old-fashioned flashbulbs are tungsten. Fluorescent tubes and electronic flash tubes are not. Just as the no. 8 filter is recommended as a standard filter outdoors, the no. 11 filter is recommended as standard for all black and white pictures (on panchromatic film) taken in tungsten light. Look again at Figure 2-6 to see why these two filters are recommended.

c. Deep yellow or Orange (Wratten no. 15, also called G or O). This filter is basically the yellow filter in overdrive. It darkens blue sky much more than the no. 8, thus making clouds stand out sharply against a moderately dark sky. It will also increase the brilliance of sunsets and will penetrate haze effectively. This filter is also effective in bringing out the texture of architectural stone, wood, fabrics, sand, snow, etc., when they are sunlit and under a blue sky. As you should expect, it will lighten colors with a lot of yellow or red in them, and will moderately darken greens.

d. Red (Wratten no. 25, also called A or R1). Red filters are very strong. They darken blue skies dramatically, making them almost black in many cases, with white clouds standing out brilliantly against them. They also add brilliance to sunset scenes, penetrate haze, and enhance textures even more effectively than the deep yellow. An even deeper red, called no. 29, can make a blue sky almost black, and its other effects are equally strong. This filter is so strong that it is chosen only for special situations, and is not used as often as the no. 25. The choice between no. 15, no. 25, and no. 29 is mainly one of deciding how dramatic you want your results to be in the finished picture.

SUBJECT	EFFECT DESIRED	SUGGESTED FILTER
BLUE SKY	NATURAL	NO. 8 (K2)
	DARKENED	NO. 15 (G)
	SPECTACULAR	NO. 25 (A)
	ALMOST BLACK	NO. 29 (F)
	NIGHT EFFECT	NO. 25 (A) PLUS POLARIZING SCREEN
MARINE SCENES WHEN SKY IS BLUE	NATURAL	NO. 8 (K2)
	WATER DARK	NO. 15 (G)
SUNSETS	NATURAL	NONE OR NO. 8 (K2)
	INCREASED BRILLIANCE	NO. 15 (G) OR NO. 25 (A)
DISTANT LANDSCAPES	ADDITION OF HAZE FOR ATMOSPHERIC EFFECTS	NO. 47 (C5)
	VERY SLIGHT ADDITION OF HAZE	NONE
	NATURAL	NO. 8 (K2)
	HAZE REDUCTION	NO.15 (G)
	GREATER HAZE REDUCTION	NO. 25 (A) OR NO. 29 (F)
NEARBY FOLIAGE	NATURAL	NO. 8 (K2) OR NO. 11 (X1)
	LIGHT	NO. 58 (B)
OUTDOOR PORTRAITS AGAINST SKY	NATURAL	NO. 11 (X1), NO.8 (K2), OR POLARIZING SCREEN
FLOWERS–BLOSSOMS AND FOLIAGE	NATURAL	NO. 8 (K2) OR NO. 11 (X1)
RED, "BRONZE," ORANGE, AND SIMILAR COLORS	LIGHTER TO SHOW DETAIL	NO. 25 (A)
DARK BLUE, PURPLE, AND SIMILAR COLORS	LIGHTER TO SHOW DETAIL	NONE OR NO. 47 (C5)
FOLIAGE PLANTS	LIGHTER TO SHOW DETAIL	NO. 58 (B)
ARCHITECTURAL STONE, WOOD, FABRICS, SAND, SNOW, ETC. WHEN SUNLIT AND UNDER BLUE SKY	NATURAL	NO. 8 (K2)
	ENHANCED TEXTURE RENDERING	NO. 15 (G) OR NO. 25 (A)

Table 2-2. Filter recommendations for black-and-white films in daylight

e. <u>Blue</u> (Wratten no. 47, also called C5). This filter has rather limited usefulness in outdoor photography, but does have uses in copy work and in separating colors when blue and another color look similarly gray without a filter. In landscape photography, this filter is useful for increasing the intensity of atmospheric haze. Why you might want to do this is discussed in the next lesson. The blue filter effectively makes any emulsion (ortho or pan) act as if it were colorblind. Greens and reds are rendered as dark grays or blacks. Blues are lightened considerably (Table 2-2).

Learning Event 6:
USE ULTRAVIOLET (UV), NEUTRAL DENSITY (ND), AND POLARIZING SCREENS

1. There are some filters that aren't designed exclusively for black and white film; they work equally well with color, too. The most important of these are the neutral density, ultraviolet, and polarizing filters.

2. Neutral density filters are colorless. They reduce the light reaching the lens without affecting its color in any way. If your camera is loaded with fast film and you find yourself unexpectedly in bright light, you may not be able to get a good exposure even though you've stopped the lens down all the way and set the fastest shutter speed. Placing a neutral density filter in front of the lens is another way of reducing the light reaching the film to a manageable level. Also, some very effective photos depend on using very long shutter speeds or very wide lens openings, or even both. A neutral density filter is often very handy in these situations (Table 2-3).

DENSITY	REDUCES EXPOSURE BY (f-STOPS)
0.10	1/3
0.20	2/3
0.30	1
0.40	1 1/3
0.50	1 2/3
0.60	2
0.70	2 1/3
0.80	2 2/3
0.90	3
1.00	3 1/3

Table 2-3. Neutral density filters

3. Ultraviolet filters (also called haze filters) look almost like ordinary pieces of glass. They are nearly colorless and require no adjustment for filter factor. They serve only to screen out ultraviolet light without affecting any of the visible colors at all. Their effect is very subtle. Outdoor scenes, especially those of distant views, often have a lot of ultraviolet light in them. You can't see it, but you can tell when it's around because the day will be hazy.

a. Haze is the scattering of blue and UV light by moisture in the air. It increases with distance, obscuring objects that are far away. You see only the visible blue portion of the haze, but your film sees the UV portion as well. If you shoot a distant scene without a UV filter, the picture you get will often look much hazier than it did to your eye. Using a UV filter will block the invisible portion of the haze so that the photograph will look about as hazy as your eye saw it. A UV filter will not make distant scenes look sharper than you saw them in the first place.

b. UV filters will also do nothing about smoke, clouds, or fog, which aren't true haze, although they often resemble it. You can make a picture look less hazy than your eye saw it by using a filter which blocks blue light, such as yellow or red. These filters will make a photo look sharper than the scene your eye saw, but they will also change the rendition of other colors. But don't forget, a no. 8 yellow filter is equally effective at cutting haze, and it corrects the tones as well.

c. So why use a haze filter at all? First of all, it has no filter factor, where a yellow filter usually requires a one stop-increase in exposure. And second, the haze filter is often placed on a lens to protect it, especially outdoors where the camera is likely to get rough use. If the haze filter gets scratched or pitted, it can be replaced for only a few dollars. But if the front element of a lens gets damaged, it can cost hundreds.

4. <u>Polarizing filters</u> look a lot like neutral density filters, and in a pinch can be used the same way, but their real purpose is far more exciting. They darken blue skies, they remove or reduce reflections from nonmetallic surfaces such as water or glass, and they penetrate haze.

a. To understand how polarizing screens work, you need to know a few more things about the nature of light. Light rays travel in straight lines. Light rays also vibrate in all directions perpendicular to their direction of travel. When a light ray hits a nonmetallic surface the vibration is in only one direction or plane, and is reflected completely. All vibrations are reflected by a bare metallic surface. Depending on the angle at which you are viewing the light reflected from an object, vibrations in other planes are reduced or eliminated completely. This reflected light - vibrating on only one plane - is called polarized light. The light from a blue sky is polarized because it is reflected off the nonmetallic particles in the atmosphere (fig 2-8).

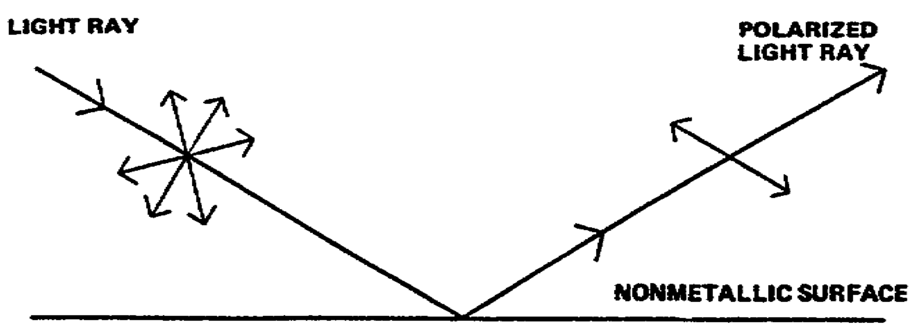


Figure 2-8. Polarized light

b. A polarizing screen will pass the vibration of a light ray in only one plane. Some polarizing screens have handles, and these screens pass the light vibration in a plane which is parallel to the handle. When the polarizing screen is passing the light vibrations of polarized light, you'll see no effect on reflections or the sky. Rotate the polarizing screen 90 degrees. In this position the screen will not transmit the polarized light, so it removes reflections and darkens the blue sky. Polarizing screens will work only with polarized light because polarized light vibrates in one direction and the polarizing screen can eliminate that vibration. If you look through a polarizing screen and rotate it until you see its maximum darkening effect, you'll see some light still reflecting from the scene. This light is the nonpolarized light in the scene and the polarized light vibrating in the plane that the screen will transmit. You'll use this light to take the picture. If you want to get the maximum effect with a polarizing screen, the angle at which you view the reflecting light must equal that of the sun (or the original light source) to the reflecting surface. For example, if the sun is shining on water at a 60-degree angle, you'll get the maximum effect with a polarizing screen when you take the picture at a 60-degree angle to the water's surface (fig 2-9).

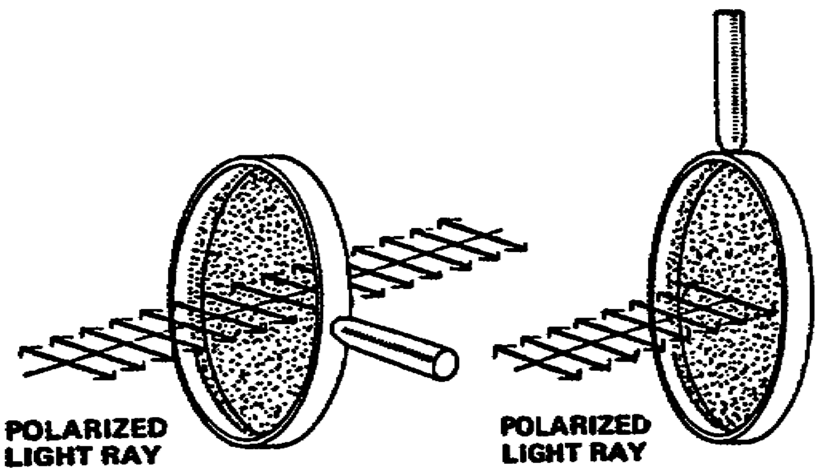


Figure 2-9. Polarized light

In the drawing on the left, the polarizing screen is transmitting the light vibration of polarized light. In the drawing on the right, the polarizing screen has been rotated 90 degrees. In this position, the screen absorbs the polarized light so that it removes reflections and darkens the blue sky.

c. A polarizing screen has a filter factor of 2.5 (increase exposure by about 11/3 stops). This filter factor applies regardless of how much you rotate the polarizing screen. If you are using a through-the-lens light meter built into your camera, rotate the polarizing screen until it shows its minimum effect, set the camera controls and leave them there. Then rotate the screen until you obtain the desired effect and make the exposure. You have removed light you didn't want in the first place and your picture will be correctly exposed. If you are making exposures based on the daylight exposure table in Lesson 1, then for the maximum effect, the scene will be sidelighted or toplighted and you will have to open a stop as you have already learned. You should also allow an additional 1/2 stop for subjects that show reflections, because reflections often make subjects look brighter than they are.

d. The polarizing filter can also darken blue skies. This is especially useful in color photography because it is the only way to darken blue skies without changing the other colors in the scene. But it is also useful in black and white photography, especially if the polarizer is used in conjunction with a yellow filter. Combining a yellow and polarizing filter will allow correction of the rendition of all the other colors in the scene and also permit a darkened blue sky. Using a red filter can also darken blue skies, as we said, but it will also darken greens considerably, possibly rendering foliage nearly as dark as the sky. The yellow-polarizer combination allows you to darken blue sky dramatically and still retain detail in foliage or other intensely green objects. An added bonus is that reds won't be unnaturally lightened either. You'll get the maximum darkening effect when you're taking pictures at right angles to the sun and the handle of the polarizing screen (if it has one) is pointing at the sun (fig 2-10). You can obtain various effects from light to dark by rotating the polarizing screen. After you decide which position of the screen produces the effect you want, be sure to keep the screen in that position when you put it over the camera lens. For example, if the handle was in the 3 o'clock position, make sure it's in the same position when the screen is on the camera. If you have a single-lens reflex camera, you can see the effects of the polarizing screen by looking through the viewfinder while you rotate the screen.

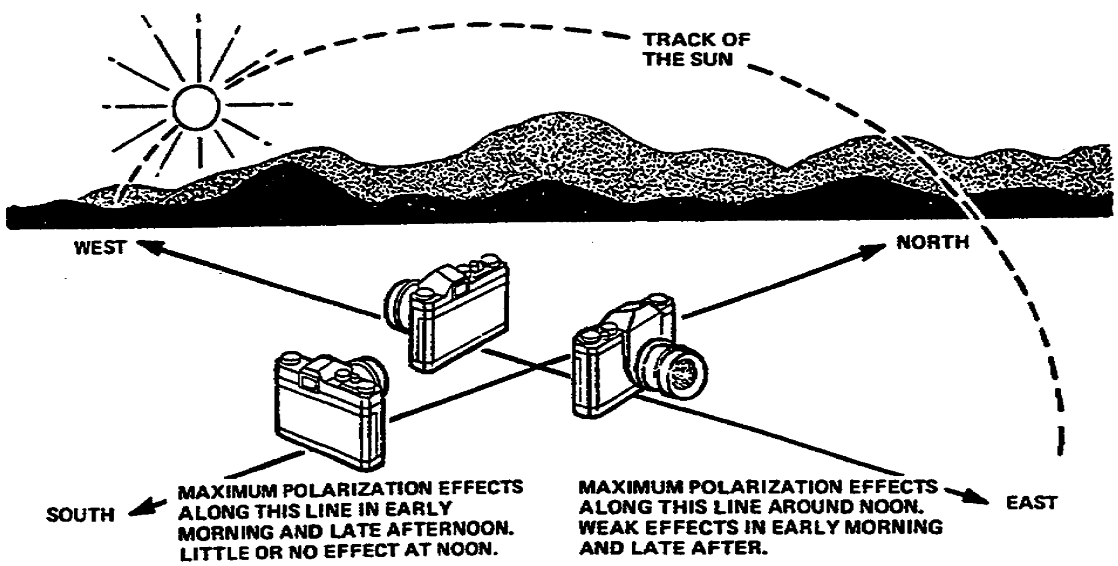


Figure 2-10. Polarizing screen

You'll get the maximum darkening effect in the sky when you're taking pictures at right angles to the sun, and the handle of the polarizing screen is pointing <u>at</u> the sun.

e. You can use a polarizing screen to reduce annoying reflections in scenes that include water, glass, or other shiny surfaces. Look through the polarizing screen while rotating it to see how you can control the reflections when you are shooting through a car window, shop window, or water. As you've read before, getting the maximum effect with a polarizing screen depends on your angle to the subject as well as the rotation of the screen. If you can't remove the reflection completely, try changing your angle to the subject. Don't expect to control reflections from bare metal surfaces, because the light reflected from these surfaces is not polarized and the screen will have no effect.

f. One last trick with a polarizing screen. If you combine a red filter, no. 25 or no. 29, with a polarizing screen and photograph a clear, sunny scene with blue sky and no clouds, you can obtain a good simulation of a moonlit night. This is admittedly a rather special effect, but it's fun to try and sometimes will produce a surprisingly effective picture.

Learning Event 7:
USE A COMBINATION OF FILTERS

1. Don't forget that when you combine a neutral density filter or polarizer with another filter, you must multiply the filter factors together and then adjust your exposure according to this combined filter factor. It isn't so easy when you combine two colored filters.

a. For example, if you were to combine a red and green filter (for some unfathomable reason) you couldn't simply add the factors. The red filter will have already eliminated almost all the green light and the green filter will eliminate almost all the red light. The combination of the two filters blocks out nearly all light, and the resulting exposure adjustment may be ten stops or more. (Ten stops is a filter factor of 1024, by the way.) This is an extreme example, but the principle still holds for lighter colored filters.

b. If you decide to use two filters in combination, hold the pair over the sensor of your meter and note how much the meter changes. This is a "quick and dirty" way of getting an estimate of what the combined factors are. Then, after you have seen the results in the developed negative, make a note of whether you got a good exposure or not, and adjust accordingly. At first glance, holding the filter over the meter sensor would seem to be a reliable way of finding a filter factor. But in some cases, especially with strongly colored filters, you can get misleading results. The color sensitivity of some meter cells differs markedly from the sensitivity of film emulsions. Red filters are notorious for this, because some older meter sensors are highly sensitive to red - much more so than film. The meter responds strongly to light through the red filter and indicates a high exposure value. But the film, less sensitive to red, will be underexposed. Don't let this throw you. Using the meter to estimate a filter factor is usually reliable; but not always.

2. This lesson only begins to cover the whole subject of photographic filters. There are hundreds of other filters, for color photography, for special effects, and for scientific and technical work. But if you can master the few filters discussed in this lesson, you will have a solid start in understanding the power and usefulness of these simple devices. Now see how well you can answer the practice questions on the next page.

Lesson 2
PRACTICE EXERCISE

1. What is film sensitive to only blue and ultraviolet light called?

   a. Unchromatic
   b. Colorblind
   c. Monochromatic
   d. Panchromatic
   e. Antichromatic

2. What are film emulsions sensitive to the red portion of light called?

   a. Unchromatic
   b. Colorblind
   c. Orthochromatic
   d. Panchromatic
   e. Trichromatic

3. Which film emulsion is (are) sensitive to ultraviolet light?

   a. Nonchromatic only
   b. Orthochromatic only
   c. Panchromatic only
   d. Both orthochromatic and panchromatic
   e. All film emulsions

4. What would a print of a red apple against a blue background look like after development if it was shot using orthochromatic film?

   a. A light apple against a dark background
   b. A dark apple against a light background
   c. A light apple against a light background
   d. A dark apple against a dark background
   e. A medium gray apple against a medium gray background

5. What is a wavelength?

   a. The distance from the bottom of a wave to the top of the same wave
   b. The distance from the source of the wave to its reflection point
   c. The length of a wave as measured along the curve of its surface
   d. The distance from the crest of one wave to the crest of the next wave
   e. The distance from the top of one wave to the bottom of the next wave

6. What is a nanometer?

   a. One thousandth of a meter
   b. One millionth of a meter
   c. One ten-millionth of a meter
   d. One billionth of a meter
   e. One trillionth of a meter

7. What is the approximate range of wavelengths of visible light for human vision?

   a. 200 to 800 nm
   b. 300 to 600 nm
   c. 500 to 1000 nm
   d. 400 to 700 nm
   e. 400 to 880 nm

8. What are the names of the additive primary colors?

   a. Yellow, blue, purple
   b. Red, blue, purple
   c. Red, yellow, green
   d. Red, yellow, blue
   e. Red, green, blue

9. What are the names of the subtractive primary colors?

   a. Red, yellow, cyan
   b. Orange, green, blue
   c. Magenta, yellow, cyan
   d. Magenta, yellow, green
   e. Yellow, cyan, blue

10. What are complementary colors?

   a. Any combination of colors that add up to white
   b. Any combination of one additive primary color and one subtractive primary color that add up to white
   c. Any combination of three or more additive or subtractive colors (but not both) that add up to white
   d. Any color except white
   e. Any combination of colors that add up to black

11. Which of the following are the three color complement combinations?

   a. Red and green, blue and yellow, magenta and cyan
   b. Red and blue, green and yellow, magenta and green
   c. Blue and yellow, red and cyan, green and blue
   d. Blue and green, yellow and cyan, red and green
   e. Cyan and red, yellow and blue, green and magenta

12. Which of the following is an advantage of gelatin filters?

   a. They have the greatest durability
   b. The have the highest resistance to fading
   c. They come in the widest selection of colors
   d. They are the easiest to mount on a lens
   e. Their colors are the most precise and pure

13. What is the chief advantage of glass sandwich-type filters over gelatin filters?

a. They have greater durability
b. They are more resistant to fading
c. Their colors are more precise and pure
d. They are less expensive to buy
e. They can be mounted on more types of lenses

14. Why are dyed-in-the-glass filters so expensive?

a. They are in little demand; therefore the cost is higher because of their limited production
b. They're used only by professionals, and are priced accordingly
c. They are difficult to manufacture to consistent and precise colors
d. None of them are made in the United States. They are all imported and therefore cost more

15. Which of the following filter colors would darken a blue object <u>most</u> in the final print?

a. Light yellow
b. Dark yellow
c. Green
d. Red
e. Blue

16. You took a black and white photo of a man wearing a green shirt standing in front of a red brick wall. When you made a print, both the shirt and the wall came out a very similar shade of gray. Which of the following filters would have made the green shirt darker than the wall?

a. No. 8
b. No. 11
c. No. 47
d. No. 25
e. No. 58

17. (Refer to the situation in question 16.) Which of the following filters would make the wall darker?

a. No. 8
b. No. 11
c. No. 47
d. No. 25
e. No. 58

18. What filter is recommended for normal use with panchromatic film outdoors?

a. No. 8
b. No. 11
c. No. 15
d. No. 29
e. No. 58

19. Which filter is recommended for use with panchromatic film in tungsten light?

a. No. 8
b. No. 11
c. No. 15
d. No. 47
e. No. 58

20. Which of these filters would you use to <u>enhance</u> the appearance of haze in the final print?

a. No. 8
b. No. 15
c. No. 29
d. No. 47
e. No. 58

21. A filter factor of 2 means you must (increase or decrease) your exposure settings by ___________ stop(s).

a. Decrease, 2
b. Increase, 2
c. Decrease, 1
d. Increase, 1
e. Increase, 1/2

22. You are using Plus-X film (ISO 125) and plan to use a No. 15 filter for the entire roll, which you expect to shoot under a wide variety of outdoor lighting conditions and intensities. Rather than calculate a filter factor adjustment for each exposure, you decide to adjust the film speed setting on your light meter. What would you use as a film speed setting?

a. 34
b. 64
c. 50
d. 125

23. You are photographing soldiers on a 2-mile run for a physical fitness test. Your camera is loaded with ISO 400 film. You want to use a slow shutter speed to cause the picture to blur a little, enhancing the feel of speed. But the sun is shining brightly and even when you stop the lens all the way down, you still must use a 1/250 second shutter speed. What strength ND filter do you need to use a 1/60 second shutter speed and still get a good exposure?

a. 0.30 ND
b. 0.60 ND
c. 0.90 ND
d. 1.20 ND
e. 1.50 ND

24. Should you use a UV filter to reduce the amount of haze visible to your eye in a black and white photo? Why or why not?

a. Yes, because haze is mostly UV and blue light and the filter will remove this effectively
b. Yes, because haze is entirely UV and only a UV filter is effective at blocking it
c. No, because haze is not made of UV light and the filter will have no effect at all
d. No, because a deep red filter would do a better job of removing visible haze
e. No, because the UV filter would remove the portion of haze invisible to the eye, with no obvious effect on the photo

25. When would you use a polarizing filter with black and white film?

a. When you wish to darken a blue sky
b. When you wish to reduce or remove reflections from metallic surfaces
c. When you wish to darken an overcast sky
d. When you wish to separate reds and greens which might appear as similar shades of gray

26. What is the effect of using a No. 25 filter with orthochromatic film?

a. No effect
b. No exposure
c. Reds lightened to almost white
d. Greens and blues would appear almost black
e. Greens only would be darkened

27. If you are using a yellow filter (factor 1.5) with a polarizing filter, how should you change your camera's exposure settings?

a. Decrease the ISO scale to 3.75 times the normal film speed
b. Decrease the ISO scale to 0.25 times the normal film speed
c. Increase the ISO scale to 5 times the normal film speed
d. Increase the ISO scale to 0.25 times the normal film speed
e. Close the lens 2 stops from the indicated exposure setting

LESSON 3

PRINCIPLES OF PHOTOGRAPHIC COMPOSITION AND PERSPECTIVE

TASK

Identify the procedures and techniques of employing photographic composition and perspective.

CONDITIONS

Given information and diagrams pertaining to the theory of photographic composition and perspective.

STANDARD

Demonstrate competency of the task skills and knowledge by correctly responding to a minimum of 80 percent of the multiple-choice test covering the theory of photographic composition and perspective.

REFERENCES

TM 11-401
TM 11-401-1

Learning Event 1:
USE THE BASIC PRINCIPLES OF COMPOSITION

1. Composition in photography is the process of combining or arranging all the elements of a scene into a particular position or relationship within the space of the photograph. When all parts of the scene are combined to form one harmonious whole, the result is a photograph having good composition. To produce a really striking photograph, an interesting subject is required. A considerable amount of talent for presenting the subject in an interesting manner is also required.

2. This lesson is the easiest and the most difficult lesson in this subcourse. It is the easiest because there is almost no arithmetic involved. But it is also the most difficult lesson to <u>really</u> learn. The only way to learn-composition is to look at a lot of pictures (good and bad) and decide why they are good or bad. Then load up a camera and take pictures - lots of pictures - and look at them the same way you looked at the pictures taken by others. That last part is particularly difficult because it's hard to be honest with yourself; but if you can do it, you'll eventually develop a genuine understanding of composition.

3. There is only one unbreakable rule of composition: good composition enhances the ability of a photograph to communicate a message; bad composition detracts from it. The ability of photographs to communicate is the main reason that the Signal Corps - the Army's communicators - is the proponent for

all Army pictorial photography. If a photograph doesn't say something, then it's not a good photograph. This is true of all photographs, not just those used by the Army. Keep in mind that any of the principles and techniques of composition discussed in this lesson can be ignored, but only if doing so serves to make the message you intend to send clearer, more specific, or more vivid.

4. With that in mind, there are several basic principles which most often lead to well composed photographs. They can't all be used all the time, but some of them are present in every picture.

a. Simplicity. Almost all good photographs are basically simple. Simplicity means that the photograph contains no extraneous or pointless elements - or at least as few as possible. It also means that a picture doesn't try to tell too much. To explain, suppose you were told to take a picture of a portable field wire switchboard in a tactical setting. Now this is a fairly small board that sits on a field table or packing case and is operated by one soldier. It's usually located in a company headquarters in a support area because it's not designed to move around a lot. You find one set up outside a tent in a supply yard headquarters.

(1) First of all, you probably wouldn't take an overall picture of the entire supply area and all the stockpiled items there, with the board almost invisible because it's so small. The fact that this particular board is located in a supply yard is probably not important. There are many types of places that would be equally logical to find this switchboard, and a supply yard is only one of them. And the small size of the switchboard's image would make it difficult for someone looking at the picture to realize what it was you were trying to tell them about; they might just think it was a picture of a supply yard and let it go at that.

(2) So you simplify. You move in close to be sure that there is no question that the switchboard is what the picture is about. You might choose a camera angle to show that the board is outdoors, that it is located near a tent, that there is a camouflage net in use nearby, and that the operator is wearing combat equipment. You could move closer and eliminate the soldier and the tent. However, if you move too close, the photo may become so simple that the message is lost. If you showed an extreme close-up of the switchboard so that its surroundings were not visible, the goal of showing a typical field setting would be lost and the photo would fail to send the message you intended.


Figure 3-1A. Simple composition

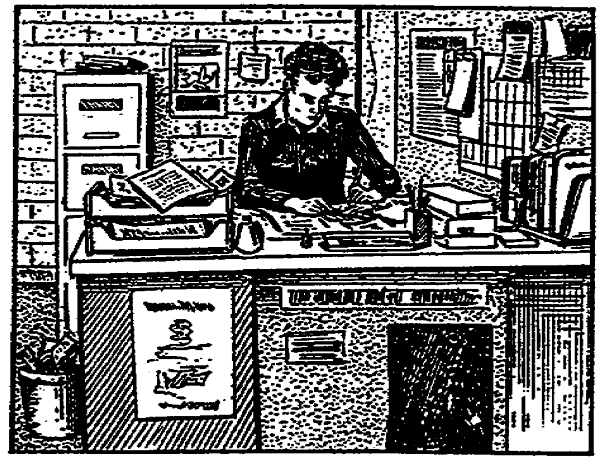


Figure 3-1B. Cluttered composition

Figure 3-1. Simple composition is usually best

(3) But what if the message you wish to send is more complicated than that? What do you do then? Most likely, you would take several pictures, each telling a small part of the story until you have enough images (all well composed) to tell the complete story. This isn't much different from writing. It's possible to tell the whole history of the world in one sentence, but it is either going to be a very long and complicated sentence, or a lot is going to be left out. That's why paragraphs and chapters were invented. It' much the same with photos.

b. Point of Interest: This is related to simplicity. It means that a photograph should have an obvious subject, something that draws the viewers attention. In the above example, the switchboard would be the point of interest. Note that the term is "point", not "points".

(1) Usually, the center of interest should not be dead center because this tends to have a hypnotic effect on the viewer. The eyes go to the center almost immediately and stay there. The rest of the picture is lost.

(2) The effect of the picture might also be lost if the center of interest is too near the edge of the picture.

(3) Most good photos restrict themselves to a single main point of interest, with all other elements of the picture made secondary in importance. This isn't always true, and you should keep your eye and mind open to the possibilities of using two or more equal points of interest when the situation calls for it. Just keep in mind that such situations are relatively rare.

Figure 3-2. A single point of interest is usually best

c. Balance. Balance is the arrangement of the pictorial elements - such as light and dark tones or heavy and light visual masses - which avoids making a picture seem too heavy in one area without some counterbalancing value elsewhere.

(1) The most formal balance is a symmetrical arrangement of similar objects. You see it in any group shot of people where everyone is lined up in a single row with the tallest in the middle and then in regular order of descending height with the shortest people at the outer ends. Often, this is the only way to achieve balance in a photograph, but it frequently results in a rather static and uninteresting picture. Nothing seems to be happening or about to happen in symmetrically balanced picture. The impression is given that everything is over with and you are showing only the aftermath.

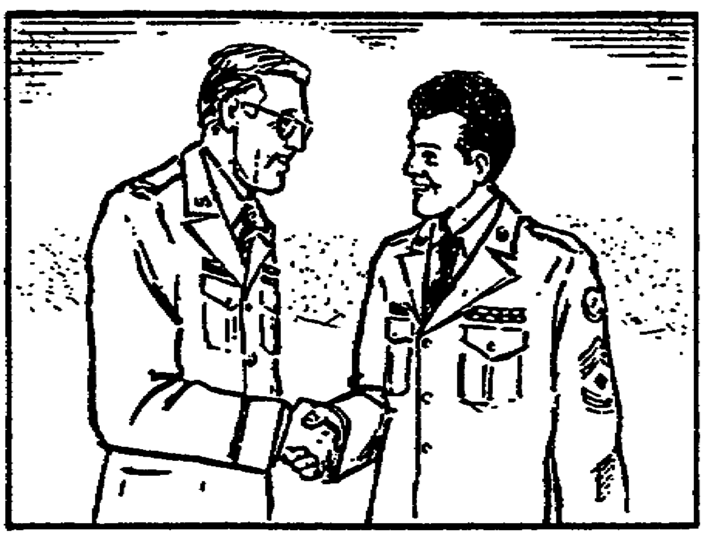


Figure 3-3. Symmetrical balance

(2) It isn't necessary to use only symmetrical arrangements to obtain balance. Dissimilar objects, even ones of dramatically different sizes, can be balanced by adjusting their placement in the picture. For example, you might place a building at some distance in the left background and a person much closer up in the right foreground. Even though the house is really much larger, the image of the person balances the house because, since it is closer, it is visually the same size as the house. We'll discuss this more when we get to perspective.

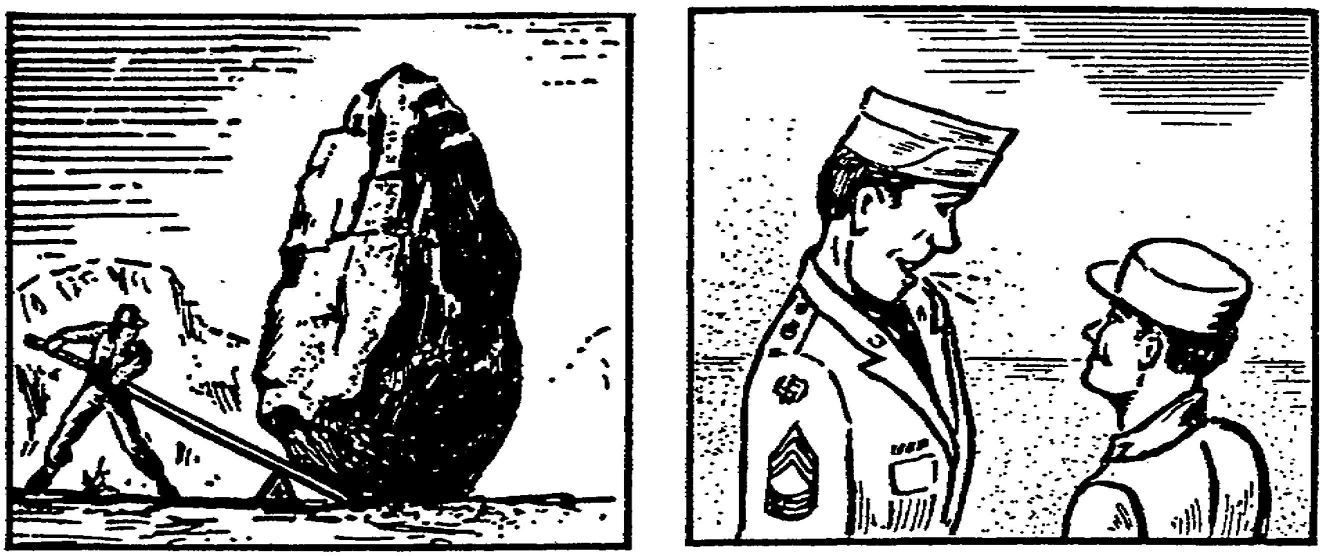


Figure 3-4. Dissimilar objects can also be balanced

(3) Just as it usually isn't good to place the subject dead center in a picture, it also is usually not good to split the picture in half; placing the horizon line exactly halfway between the top and bottom or placing the vertical edge of a building in the center. When placing the horizon line, either the sky or the ground should dominate. Placing the horizon about one-third of the way from the top or bottom edge of the picture is usually a good rule of thumb unless you have a compelling reason to do otherwise.

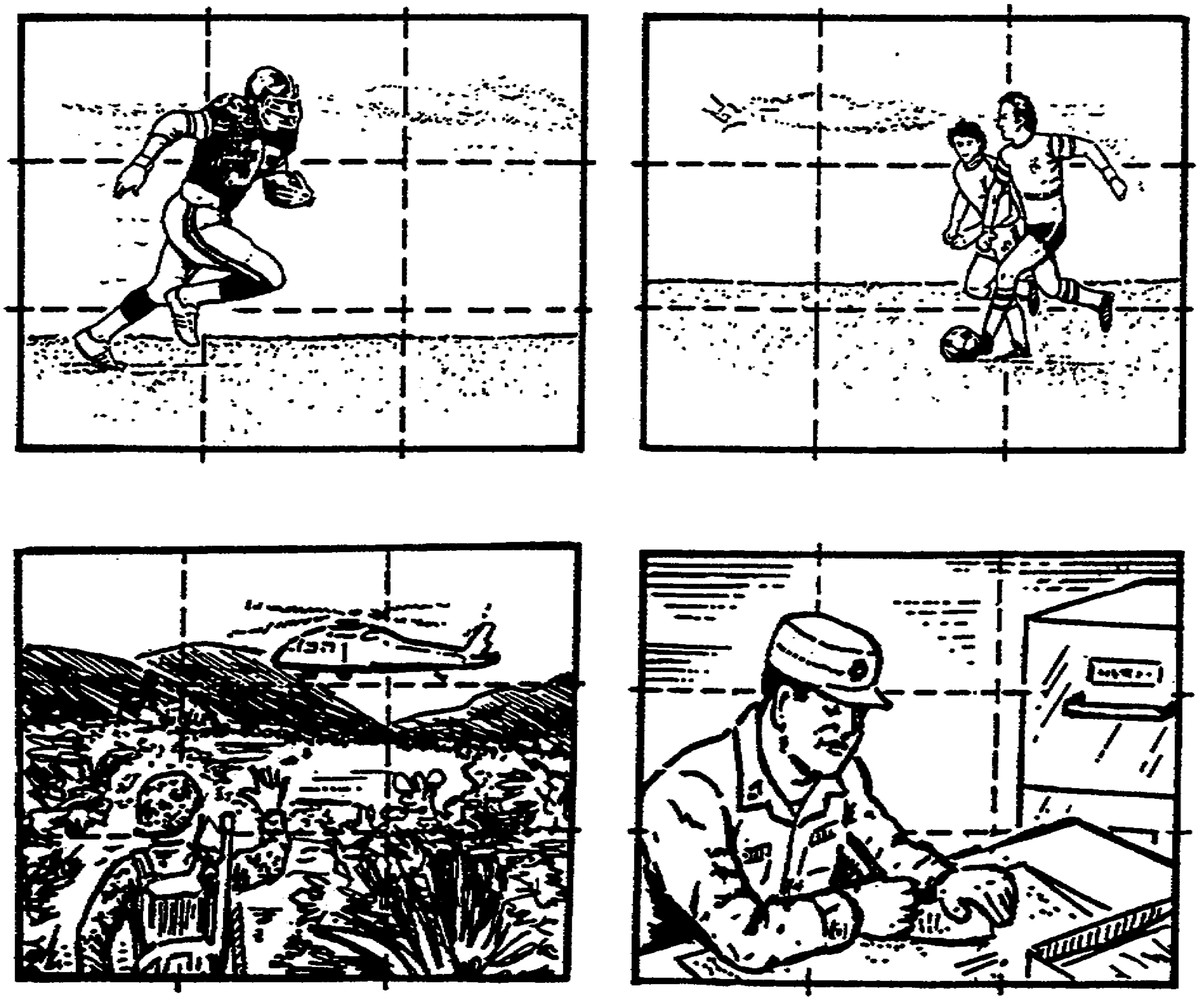


Figure 3-5. Dividing the picture area into thirds often gives you good locations to place important picture elements

d. Rule of Thirds. Placing objects a third of the way into the picture applies in other ways too. If you mentally divide the frame of your viewfinder into thirds, both horizontally and vertically, you will have a grid that looks something like Figure 3-5. The four points where the dividing lines intersect are often good places to place your subject. Remember, we said that dead center subjects were static and slightly hypnotic; but if not in the center, where? Now, by imagining where those lines cross, you have a good point off-center, but not too close to the edge, to position your subject. In fact, you have four of them, and you can choose any one of them to suit your purpose. The points work well whether the camera is held horizontally or vertically, which brings us to our next point - format.

e. Format. The format of a picture is simply its shape. Square, rectangular, even circular or key-hole shaped. Most cameras today are designed to take rectangular pictures, and most printing papers are precut to rectangular shapes. A few cameras are still made to take square pictures. Whatever shape your negative or paper is, there is no law that says you must force your photo to fit what you have. You may make a long, thin picture or a square picture, or anything in between, if the scene calls for it. Admittedly, the shapes you are given by the manufacturers are the most popular, but they aren't engraved in stone. Paper is easily cut. One of the easiest ways to control format is to turn the camera from horizontal to vertical. This is a simple but distressingly underused advantage of cameras that take rectangular pictures. If your subject is taller than it is wide, it probably would be better suited to a vertical format. But many photographers stubbornly hold the camera horizontally and back away until the long subject will fit into the short side of the picture frame. It is so much easier to just turn the camera on its side and fire away.

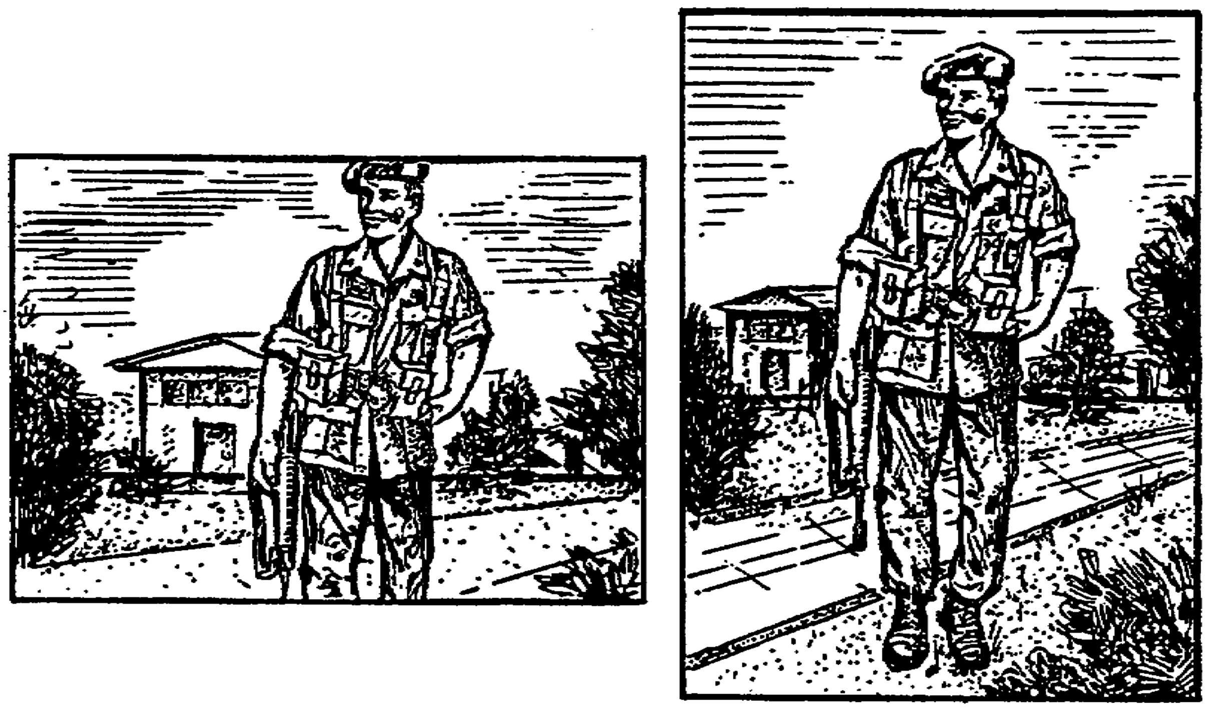


Figure 3-6. Choose a format which fits your subject

f. Lines. Lines are one of the strongest compositional tools available to the photographer (or for that matter, any visual artist).

(1) Few things serve better than lines to direct the viewer's attention to a specific spot in a scene. Lines that do this are called <u>leading lines</u>, and they can be explicit or implied. Explicit leading lines are those you can actually trace out with your finger in the picture. Fence lines, pathways, roads, and railroad tracks, are all examples of explicit leading lines. The most common example of an implied line is the direction of a person's gaze. If a person in a photograph is seen to be looking at something else also in the picture, the viewer's eyes are almost compelled to look at the object too. No actual line can be seen, but the idea of a direction of gaze is extremely powerful. This becomes a problem if lines become contradictory. If two or more people are shown in a photo and they are each looking at something different, then the viewer's attention is torn between the different subjects, usually to bad effect.

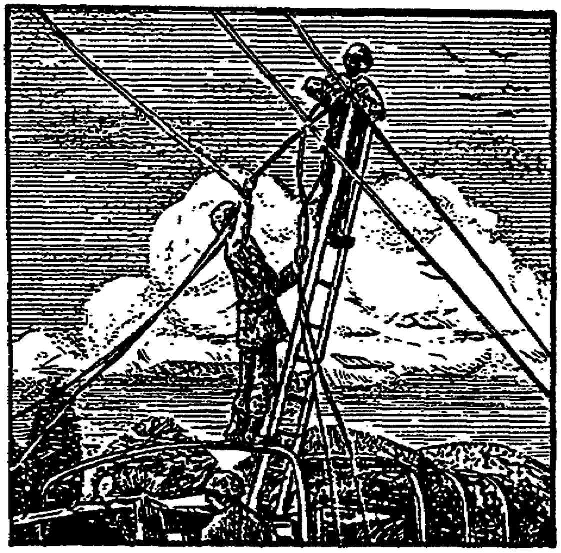
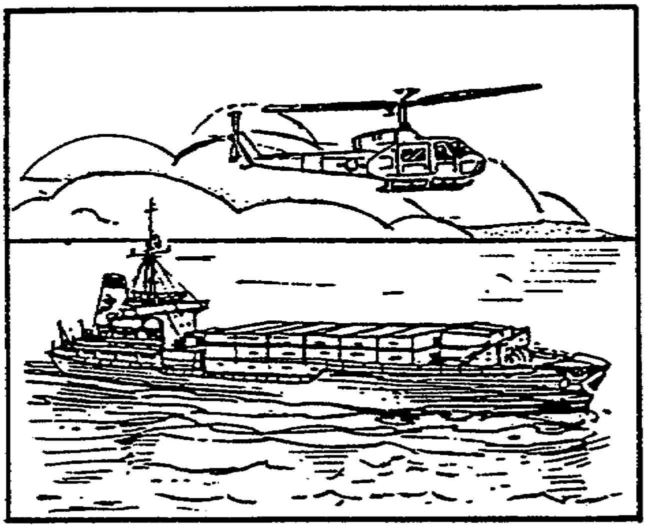


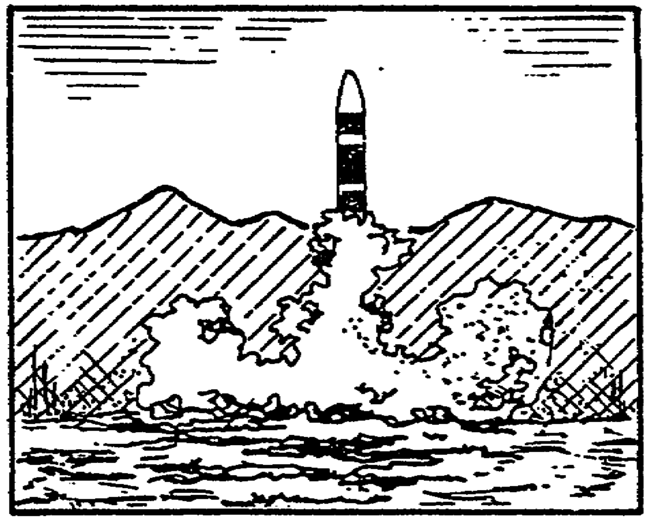
Figure 3-7. Explicit leading lines

Figure 3-8. Implied leading lines

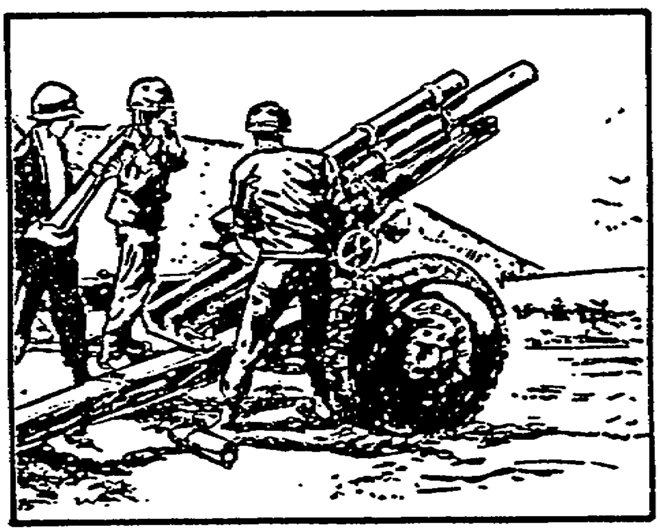
(2) Lines are also used for other purposes than to direct the viewer. They often can be used to set a mood in the picture. Horizontal lines depict stability, calmness, or peacefulness. Vertical lines are often used as symbols of strength, power, and integrity. Diagonal lines strongly imply action and speed, and curved lines can imply grace and rhythm. These lines can also serve double duty as leading lines, of course. A terribly overworked example of this is the use of an "S" curve showing a path or stream leading from the foreground to a building or other subject in the distance. The reason it's so overworked is that when it's well used, it's terrific. But often photographers are so taken with an "S" curve, any old "S" curve, that they put it in their picture whether it is appropriate or not, and usually it's not. Don't disdain the "S" curve, but use it sparingly, and be sure it has a purpose.



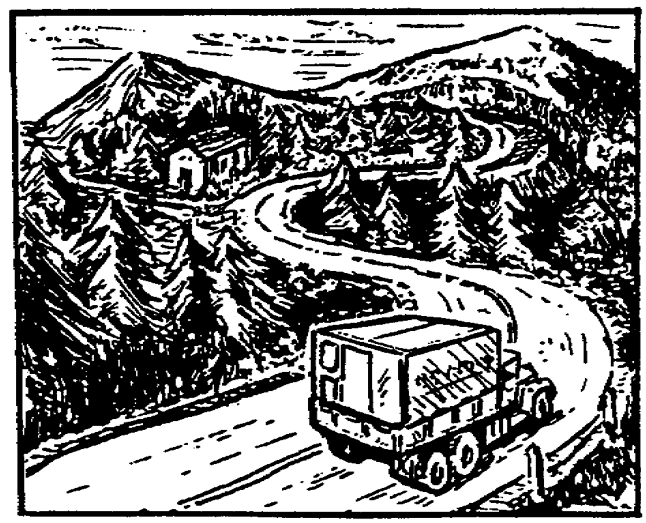
A. Horizontal



B. Vertical



C. Diagonal



D. Curved

Figure 3-9. Using lines to suggest moods

Learning Event 2:
CREATING THE ILLUSION OF DEPTH

1. Perspective. Perspective is easily achieved with a camera. Aim your lens at anything which isn't a flat wall and you will probably get at least some perspective effect. It's inherent in the way a lens forms an image. A good photographer controls the strength of the perspective effect to suit his purpose.

a. Perspective is simply the illusion of depth caused by the change of the apparent size of an object as its distance changes. The most obvious example of the perspective effect is the apparent convergence of railroad tracks (or any set of parallel lines) as they disappear in the distance. Leading lines can for this reason also be perspective lines. But perspective doesn't apply only to lines. It is also the reason a distant mountain will appear smaller than a nearby person, even though their actual sizes differ immensely.

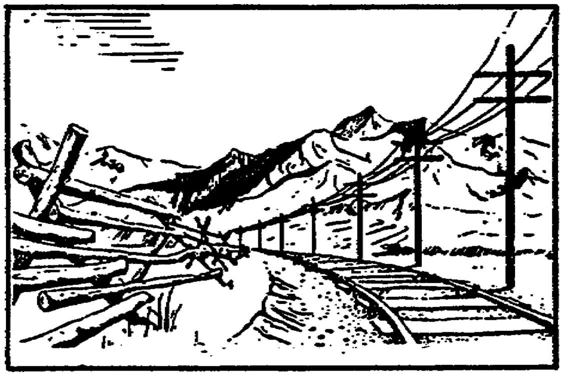


Figure 3-10A. "Strong" perspective

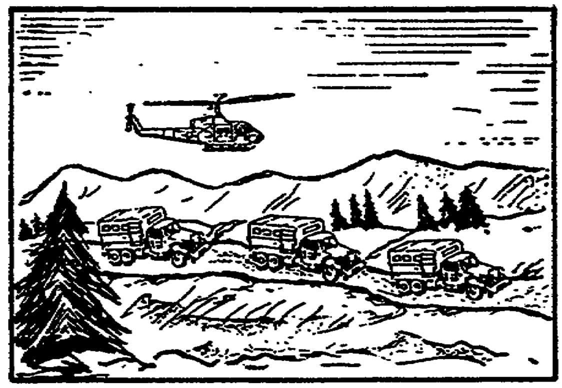


Figure 3-10B. "Weak" perspective

b. To adjust perspective, think of a picture having three general areas of depth, called foreground, middle distance, and background. By placing something in each of these picture distances, you can emphasize the depth of a picture, particularly if you use familiar objects because the viewer has a good idea of their actual size. The difference between what the viewer knows is an object's actual size with its apparent size in the picture will give strong clues about relative distances and will let him draw a conclusion about how far apart things really were. A simple example may make this clearer. Suppose you took a picture of a very simple landscape: three trees on an open plain. The first tree is very large. The second tree, which is the same type and general shape, and clearly full grown, is considerably smaller, and the third, also the same type, is quite tiny and much nearer the horizon line. A viewer would most likely conclude that there is a great deal of depth in this scene. But a similar scene in which the trees are only slightly different in size would lead the viewer to conclude that there is relatively little depth.

c. Perspective is almost entirely a matter of lens position. (The only other way to alter a perspective is by the use of the swing and tilt controls on view cameras, but these are not being considered here). Changing lens focal lengths doesn't really alter the perspective of a scene; it only appears that way. Changing focal lengths does allow you to move the camera to a different position (nearer to or farther from the subject) while keeping the main subject the same size. By moving the camera, you have altered the perspective. Changing the lens focal length alone didn't change the perspective one bit. You can prove this to yourself if you have a camera with two or more lenses of different focal lengths. Without moving the camera, take a picture of a scene with some depth to it with a different focal length lens. When you have developed the negatives, first make a print of the picture taken with the longest focal length lens. Then make a print with a negative of a shorter lens but enlarge the image until it is the same size as your first print. Except that the picture made from the greater enlargement will be fuzzier and grainier, it will look the same as the first picture. You can do this with every focal length lens you have until you get tired. The result will be the same every time.

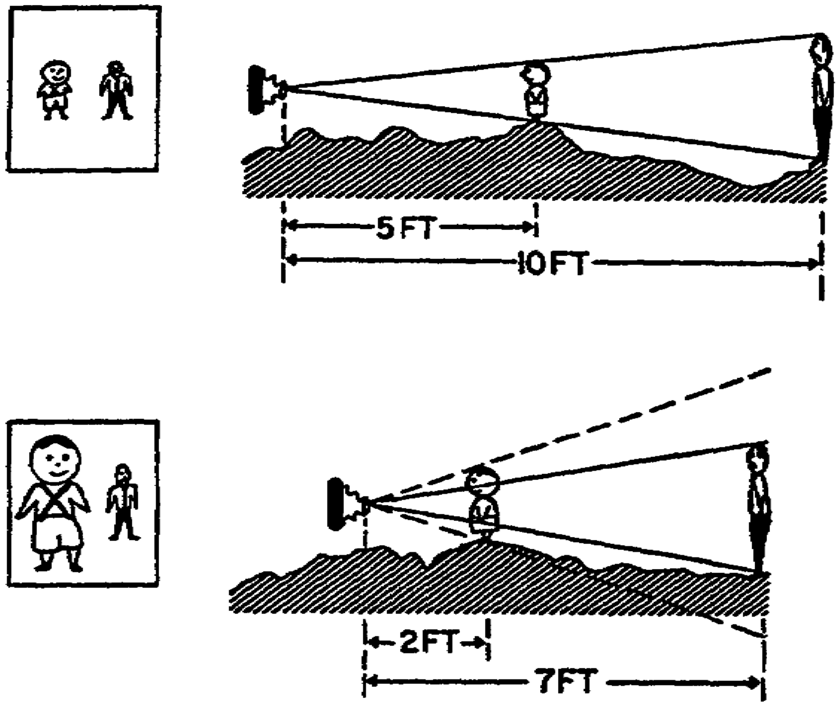


Figure 3-11. Perspective can be controlled by using different focal lengths to allow you to change camera position

d. To show how lens focal lengths allow you to modify apparent perspective, try this experiment. Using the same lenses, take a picture of a person in the foreground and a distinct background, such as a building. Only now, each time you change lenses, move your camera so that your main subject remains the same size. If you start with your longest lens, for example, you would move closer to your subject each time you changed to a shorter lens. This time, when you make your prints, the apparent size of the background, in relation to your (consistent) subject size will change. The background in the picture taken with the long lens will appear much larger, and therefore closer, than the same background taken with the shorter lens. But the difference is entirely the result of your having moved the camera between each shot. The lens only helped you keep your subject's size the same in each. If lenses had no limit to their resolving power, and if film didn't have similar limits, there would be no need to make any telephoto effect you wanted by simply changing your camera position and enlarging the negative as much as you needed. Unfortunately, physics and chemistry don't cooperate, and you're going to have to carry several lenses if you want to control perspective in this way.

e. Perspective composed of strong lines which give a great sense of depth in a picture is called "strong perspective". It is most easily achieved with wide angle lenses and subjects which contain a lot of explicit leading lines and depth clues. Perspective which de-emphasizes the depth in a picture is called "weak perspective." It is achieved, not too surprisingly, by using longer focal length lenses and avoiding lines which indicate depth.

Closely related to perspective is overlap. This is one of the oldest methods in existence to indicate depth, having been in use since before the ancient Egyptians. It is also very powerful. When one object overlaps another, it is an almost inescapable conclusion that it is nearer the viewer. This may seem obvious to the point of insulting your intelligence, but its use should not be sneered at just because of that. It is a valid technique which, as with all techniques, should be used consciously and with thought.

2. "Aerial perspective" is a term you might come across in photo texts. It isn't perspective like we've been discussing, but refers to the effects of atmospheric haze in giving clues to the depth in a scene. Remember in Lesson 2 when you learned that a blue filter would accentuate haze? You were promised that you'd find out in this lesson why you might want to do that, and here it is. Very distant objects usually look much less distinct and somewhat lighter in tone than nearby objects. This is mainly due to the obscuring effects of haze. In deserts and at high altitudes, two places where there is relatively little haze, distant objects seem misleadingly near because we expect them to look less sharp and distinct than they are. The effect carries through in photographs. A distant mountain, with its colors muted, its details partly obscured, and a lighter overall tone, will appear much farther away than another mountain which is sharply defined and with contrasting tones, even though the two are actually the same distance. Using a blue filter, which emphasizes haze, can actually increase the apparent distance of an object.

3. The play of light and shadow on an object can give great clues about its shape in the third dimension. "Flat" light, which has no defined direction, is very poor at making a three-dimensional object look that way. But light which has a definite direction, casting shadows and creating highlights, can make the same object seem to jump out of the plane of the paper and seem much more real. In order to do this, the light should strike the subject at an angle. If the subject is strongly backlit or front lit, the effect is reduced because neither type produces shadows across the surface of the subject. To be most effective, the light should strike the subject obliquely.

Learning Event 3:
USE ADVANCED COMPOSITIONAL TECHNIQUES

1. In a way, everything that has been discussed so far relates closely to compositional technique, but there are some practical applications of composition techniques which can be used effectively to help your pictures become more interesting and communicative. These make use of the basic principles to suit the photographer's purpose.

a. Framing: Every photograph is framed, if only by the edge of the paper it is printed on. But this isn't the only frame you have available to you. You can focus the viewer's attention by using an element in the scene itself to create a natural frame around your subject. This is useful for calling attention to the subject, relating it to its surroundings, and creating depth in the photograph. By placing the subject in a doorway or archway, a window frame, or behind a tree branch, you create a foreground which defines the area much more effectively than just letting the scene disappear at the edge of the printing paper. Of course, these are only a few examples. Imagination and creativity play an important part in creating effective and interesting frames for a picture. And, once again, framing may or may not be appropriate for the message you wish to get across.

Figure 3-12. Framing

b. Horizon line. We've already discussed the "rule of thirds" when it comes to placing the horizon line, but how do you decide which third you should use? It's obvious that placing the horizon line low emphasizes the sky and placing it high emphasizes the ground, but how does this affect the message of the picture? Generally, emphasizing sky gives an appearance of great space and roominess, implying freedom and possibilities. By placing the horizon high, and emphasizing the ground, the usual effect is one of being earthbound, settled or limited in movement and available space.

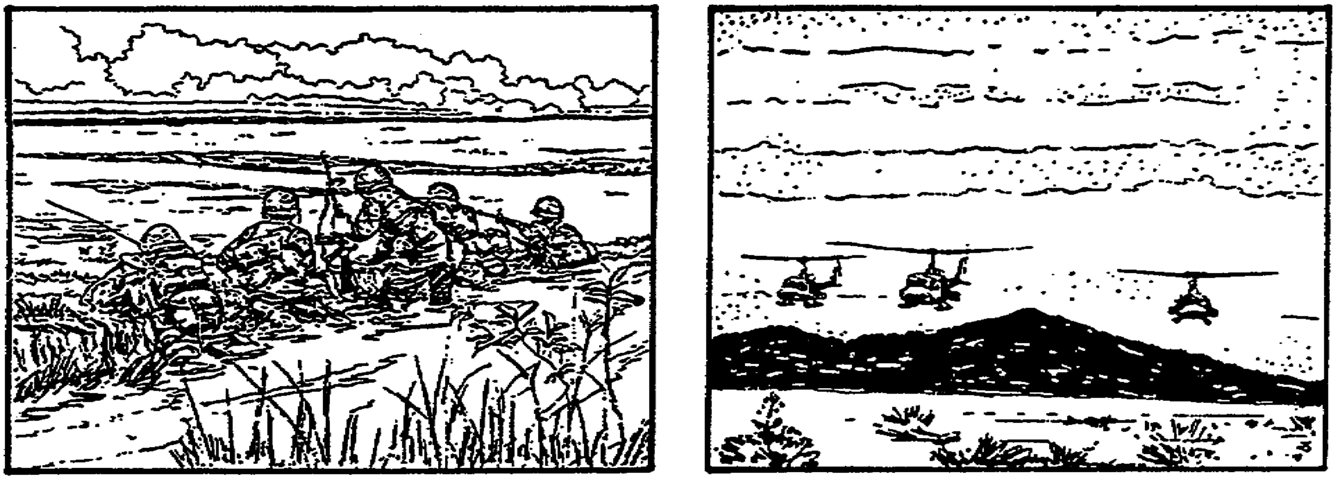


Figure 3-13. Horizon line

c. Camera angle. Careful choice of camera angle is a very powerful method of emphasizing a feeling in a picture. Choosing a low angle and shooting upward often implies power by suggesting that the subject is taller than it really is. Conversely, choosing a high angle and shooting down tends to make objects seem smaller and less threatening than they really are. Shooting at unusual angles also often helps give a picture impact or "stopping power" (it compels the viewer to look at it) because it is an angle and viewpoint which he doesn't usually experience and the novelty interests him. It makes him think, "Hey, I never thought about this in quite that way before." On the other hand, a head-on, eye level view of a subject emphasizes objectivity and ordinariness. It seems to present a subject as “Here it is. I, the photographer, have no comment. You must draw your own conclusions.” Of course, if the subject is extremely powerful of itself, the “objectivity” implied by the direct angle may not be true. In fact, just by choosing to take a picture, a photographer injects his opinion because the implication is "this is something worth having its picture taken," and that in itself is an opinion.

Figure 3-14. The right angle can have a powerful effect

d. Action. Still photographs are just that - still slices of time. But many photos are of action or activities. Since the photo doesn't move, all action must be suggested, and there are many compositional techniques available to do this. We've already discussed how diagonal lines suggest action. Two other means of showing action seem contradictory - by stopping action by using very short exposures or by blurring it by using long exposures.

(1) Either technique, properly applied, can imply that an action is taking place in the photo. In the first instance, the classic example is a photo of a boxing punch taken with an electronic flash with a very short flash duration -- 1/10,000 of a second or less. The extreme shortness of the exposure freezes everything in crisp detail. The distortion of the victim's face as the glove connects, the flying droplets of sweat suspended in mid-air, all are as crisply detailed as if they weren't moving at all. The suggestion of motion comes from the idea that such a situation can only exist for a short time, and that something happened before to cause it, and that it is unfinished. Dr. Harold Edgerton of the MIT physics lab pioneered this type of photography. One of his most famous pictures is of a bullet cutting a playing card in half. The bullet is visible, and the playing card is neatly sliced in half, the upper portion still in mid-air hasn't even had time to begin its inevitable fall to the floor. But the fact that it must fall, and the fact that the bullet must move for anything in the picture to be at all possible so strongly suggests action that nobody could miss the point.

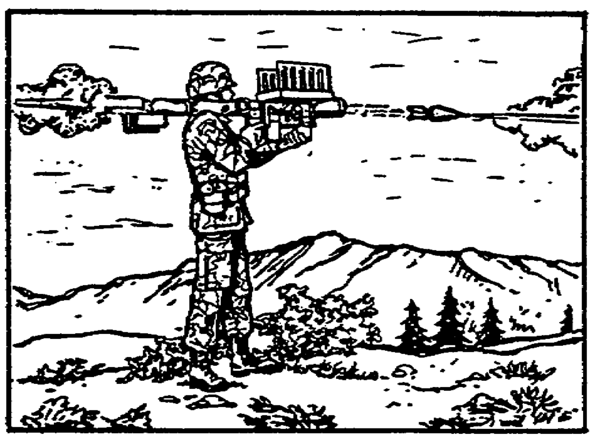


Figure 3-15. Stopping action to show action

(2) Blur is much more common for showing something in motion, mainly because unless special techniques are used (such as high speed flash), blur is difficult to avoid when shooting something which is moving rapidly. Even shutter speeds of 1/1000 or 1/2000 second will often be slightly blurred if the action is fast enough. So rather than curse the loss of sharpness, it's often better to take advantage of it by using it to show something is happening. Many photographers use slow shutter speeds deliberately to do this; just how slow is mostly a matter of experience. In the two earlier examples of showing action by freezing it; the action was implied by the instability of the event shown; in other words, things just couldn't have remained the same in the instants following the exposure. The boxing punch would have had to continue, the severed playing card had to fall. But what if

you were photographing a truck doing thirty miles an hour? If you froze it until everything was perfectly sharp, it would probably look like it wasn't moving at all. By deliberately introducing some blur, the viewer will realize that the truck was actually moving during the time the exposure was made (and by extrapolation, probably before and after as well). There are two ways to show blur.

(a) By holding the camera still and letting the action move across the picture area, the thing moving will be blurred against a sharp background. (This, of course, assumes the background is in focus. Blur caused by lack of focus isn't what we're talking about here.) This could be another good way of showing boxers in action. The speed of the gloves moving through the frame would cause them to be quite blurred, but the referee, standing relatively still, would appear much sharper. There would be no doubt about what was moving rapidly and what was standing still.

Figure 3-16. Using blur to show action

(b) Another technique is called panning. This simply means that instead of keeping the camera still, you move the camera to follow the action, keeping the image in the same place in the picture area. But since the camera is moving the background will be blurred and the subject will be sharp. You've probably seen this many times in photos of race cars or anything else which moves rapidly in a predictable way. Cars, airplanes, horse races or any other similar action can be shot while panning. But it would be very hard to pan with the action of a boxing glove since the glove's wearer is actually trying to fool his opponent (and you) about where the glove will be going in the next instant.

Figure 3-17. Panning with a moving subject is another way to show motion

2. One final technique for controlling composition needs to be discussed, and that is one called selective focus. This is the technique of manipulating the lens so that only the center of interest is in focus, and everything in front or behind is blurred. It is achieved by manipulating a lens' depth of field. Depth of field is the zone in front of and behind a plane in "perfect" focus that still appears sharp to the viewer of the photo. Theoretically, only one thin plane of any photo is truly in focus, but there is always a zone which is so close that the eye can't tell the difference. Outside this zone, things look more and more blurred.

a. The size of this zone can be easily controlled. It depends on three things: the distance the lens is focused on, the focal length of the lens, and the size of the aperture. In general, depth of field is decreased by focusing closer, using a longer focal length lens, and by opening the lens aperture. With a very long focal length lens focused closely and opened to a wide aperture, the depth of field can be reduced to a very short distance often an inch or less. By adjusting any combination of these three factors, you can control the zone of sharpness fairly accurately.

b. By reducing the depth of field, you can isolate the subject you want to draw attention to from the foreground, the background, or both. Selective focus (which this is) is useful for solving a number of problems. If there is something distracting in the background, throwing it out of focus can often reduce, or even eliminate the offending object. Selective focus can also enhance the illusion of depth by making the subject stand out against the background. And, as already noticed, selective focus can force the viewer's attention where you want it.

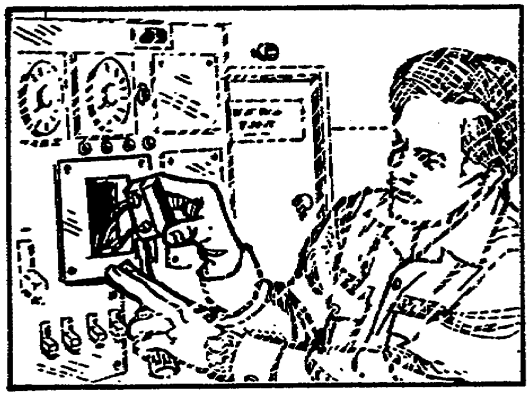


Figure 3-18. By restricting depth of field, you can draw attention to your subject

3. The subject of composition is enormous, and this lesson only begins to cover it. But by now you should know that good composition is more than just a matter of making pretty pictures that are pleasing to look at. Good composition is mainly about making pictures to communicate on more than a narrowly literal basis. Good composition attracts the viewer's attention, focuses his eyes on the subject at hand, and clarifies the message you intend to send in the photograph. It doesn't matter if the message is something as simple as "here is a left-handed jammerfritz" or more complex, such as "here is why air pollution is bad for you and should be cleaned up no matter what the cost may be". No matter how simple or complex your goal, properly applied composition will help you achieve what you set out to do when you first thought of taking the picture. Now, see how well you can do on the practice questions beginning on the next page, and after that, on your examination. Good luck and good pictures!

Lesson 3
PRACTICE EXERCISE

1. What is necessary to tell the story when minimizing all distracting or meaningless elements from a picture?

   a. Balance
   b. Symmetry
   c. Rule of thirds
   d. Composition
   e. Perspective

2. What is the only basic, unbreakable rule of composition?

   a. Good composition always results in pretty pictures.
   b. Good composition always improves a picture's ability to communicate a message.
   c. Good composition means always having your pictures symmetrically balanced.
   d. Good composition is only absolutely necessary when a picture is intended for publication in print.
   e. Good composition is always determined by mathematical principles.

3. How many points of interest are normally found in a good photograph?

   a. One
   b. Two
   c. Three
   d. Four
   e. Five

4. In general, where is the <u>least</u> desirable place to locate a photograph's point of interest?

   a. Near the top
   b. Toward the left side
   c. Toward the right side
   d. At dead center
   e. Near the bottom

5. The arrangement of light and dark tones or visual masses to avoid making a picture seem too "heavy" in one area is called _____________.

a. Symmetry
b. Perspective
c. Composition
d. Balance
e. Panning

6. A formal group shot, with the tallest person in the center of a single row and successively shorter ones arranged to each side is a classic example of ______________________.

a. Symmetrical balance
b. Lateral balance
c. Depth of field
d. Formal composition
e. Informal composition

7. What is the "rule of thirds"?

a. Picture areas should always be divided into three equal areas of interest.
b. The best place to place horizon lines is one-third of the distance between the top or bottom edge of the frame and the center of the image.
c. By putting the main points of interest, horizon lines or other compositional elements about one-third of the way into the image, the photographer can avoid misplacing them.
d. By placing the point of sharpest focus approximately one-third of the way between the foreground and the main point of interest, the sharpness of the picture is at its best.
e. Subjects (main points of interest) should always be placed one-third of the way outside the picture frame.

8. In a rectangular or square picture, how many points are available for using the "rule of thirds"?

a. One
b. Two
c. Three
d. Four
e. Five

9. What is meant by format?

   a. The shape of the picture.
   b. The overall placement of the compositional elements of a picture.
   c. The relationship of near and distant objects in a picture.
   d. The predominant type of lines used in a picture, particularly when referring to horizontal or vertical leading lines.
   e. Both b and c are correct.

10. What are the two main formats for a rectangular picture?

   a. Horizontal and diagonal
   b. Leading and circular
   c. Shallow and deep
   d. Horizontal and vertical
   e. Simple and cluttered

11. What are implied leading lines?

   a. Lines which appear in the photo's composition which indicate a mood, such as action, strength, peacefulness, etc.
   b. Lines which appear in a photo's composition which direct a viewer's attention, such as paths, fence lines, street lane stripes, etc.
   c. Lines which are not actually present in a picture's composition, but which are suggested by some action, used to direct the viewer's attention.
   d. Both a and b are correct.
   e. Both a and c are correct.

12. Horizontal lines most often imply what mood or condition?

   a. Action
   b. Indifference
   c. Anger
   d. Peacefulness
   e. Strength

13. What types of lines most strongly depict action?

   a. Curved
   b. Diagonal
   c. Horizontal
   d. Vertical
   e. Implied

14. Strength, power, and integrity are often shown through the use of ____________________ lines.

a. Horizontal
b. Implied
c. Diagonal
d. Vertical
e. Curved

15. What is linear perspective?

a. The illusion of depth created by the overlap of near and distant objects.
b. The illusion of depth created by restricting the zone of sharp focus in a photograph.
c. The illusion of depth created by the effects of highlights and shadows.
d. The illusion of depth created by the differences in the size of near and distant objects.
e. The illusion of depth created by the effects of atmospheric haze.

16. What is aerial perspective?

a. The illusion of depth created by the overlap of near and distant objects.
b. The illusion of depth created by choosing a high camera angle, giving the appearance of shooting an aerial photograph.
c. The illusion of depth created by the effects of highlights and shadows.
d. The illusion of depth created by the differences in the size of near and distant objects.
e. The illusion of depth created by the effects of atmospheric haze.

17. If you wish to use light to control the illusion of depth in a picture, and you wish to make the depth appear as shallow as possible, what kind of light would help you achieve this?

a. Back light
b. Hard side lighting
c. Soft, flat lighting
d. Top lighting
e. Cross lighting

18. If you wish to <u>emphasize</u> the appearance of depth in a photo, what kind of light would you use?

a. Spot lighting from above
b. Hard front lighting
c. Hard side lighting
d. Soft cross lighting
e. Soft flat lighting

19. Placing a subject in a doorway or archway is an example of what compositional technique?

a. Leading lines
b. Framing
c. Balance
d. Selective focus
e. Perspective

20. How would you place the horizon line in a photograph if you wish to emphasize freedom, or a wide expanse? (only 3 choices given)

a. Near the top
b. Near the bottom
c. At the center

21. You are photographing a soldier who is using a sledgehammer to drive an electrical grounding stake near a signal van. What camera angle would you choose to emphasize the power of the soldier's strength? (only 4 choices given)

a. A high angle, looking down
b. An angle from about the soldier's eye level
c. An angle from about the photographer's standing eye level
d. A low angle, looking upward

22. You are about to photograph a soldier rappelling down a cliff. Which of the following would be most likely to imply the greater action?

a. A shot from a high angle looking down of the soldier at the very beginning of a bound, still against the cliff face, knees bent.
b. A shot from a high angle looking down of the soldier in mid-bound and several feet from the cliff, suspended by only the rope.
c. A shot from a low angle of the soldier in mid-bound, the soldier silhouetted against the sky.
d. A shot from a position level with the soldier as he clings to the cliff rock immediately after he has finished a bound.
e. A shot from a low angle looking up of the soldier immediately at the end of a bound, clinging to the cliff rock.

23. What is "panning"?

  a. The technique of using a slow shutter speed while holding the camera steady in order to depict a moving subject by blurring its motion.
  b. The technique of using a slow shutter speed while following a moving subject with a camera in order to depict action by blurring the background.
  c. The technique of using a very fast shutter speed to freeze the action of a subject.
  d. A method of creating "freeze frames".
  e. Both b and d are correct.

24. What is meant by the term "stopping power"?

  a. The ability of a camera and lens to stop the action of a moving subject by freezing it.
  b. The impact of a photograph, making a viewer stop and take notice.
  c. The maximum f/stop a lens possesses.
  d. The ability of a photograph to show action.
  e. The potential sharpness of a lens.

25. What is meant by "selective focus"? How is it achieved?

  a. The ability of a lens to focus sharply on one plane.
  b. The ability of a lens to focus sharply over a wide range of distances.
  c. The technique of restricting the zone of sharpness of a lens only to the subject to which the photographer wishes to call the viewer's attention.
  d. The technique of using small f/stops and long shutter speed to make the range of sharpness as great as possible, so that there are no distracting out-of-focus areas in a picture.
  e. The technique of using a slow shutter speed while following a moving subject, causing it to be sharp against a motion-blurred background.

ANSWERS TO PRACTICE EXERCISES

Test Question Number	Correct Response	(Learning Event	Reference Paragraph	Page)
		Lesson 1		
1	b	1	1	1
2	b	1	3a	2
3	d	1	3b	3
4	c	2	la	3
5	d	2	la	3
6	e	2	2a	4
7	a	2	2c	5
8	a	2	2c	5
9	c	2	2c	5
10	a	2	2h	6
11	b	3	2c	10
12	c	3	2	8
13	b	4	1	10
14	d	4	1	10
15	a	4	1	10
16	c	5	Table 1-7	13
17	b	5	Table 1-7	13
18	b	5	Table 1-7	13
19	d	5	3	14
20	d	5	Table 1-7	13
21	d	5	4a	15
22	c	2	2a	4
23	a	2	2a	4
24	d	5	4b	15
25	b	6	Light Meter	
26	d	6	Light Meter	
27	a	6	Light Meter	
28	e	6	Light Meter	
		Lesson 2		
1	b	2	2	34
2	d	2	3	36
3	e	1	2	31
4	b	4	1	37
5	d	1	2	30
6	d	1	2	30
7	d	1	2	30
8	e	1	4	31
9	c	1	5	33
10	b	1	4d	32

ANSWERS TO PRACTICE EXERCISES

Test Question Number	Correct Response	(Learning Event	Reference Paragraph	Page)
		Lesson 2		
11	e	1	Fig 2-3	33
12	c	3	2	36
13	a	3	3	36
14	c	3	4	36
15	d	5	2d	39
16	d	5	2c	39
17	e	5	Table 2-2	40
18	a	5	2a	39
19	b	5	2b	39
20	d	5	2e	41
21	d	4	5	38
22	b	6	Table 2-3	41
23	e	6	Table 2-3	41
24	a	6	4d	44
25	b	6	4d	44
26	a	2	2	34
27	a	6	4c	43
		Lesson 3		
1	d	1	1	52
2	b	1	3	52
3	a	1	4b(3)	54
4	d	1	4b(1)	54
5	d	1	4c	55
6	a	1	4d(1)	55
7	c	1	4d	57
8	d	1	4d	57
9	a	1	4e	57
10	d	1	4e	57
11	c	1	Fig 3-8	59
12	d	1	4f(2)	59
13	b	1	4f(2)	59
14	d	1	4f(2)	59
15	d	2	1a	60
16	e	2	2	63
17	c	2	3	63
18	c	2	3	63

Test Question Number	Correct Response	(Learning Event	Reference Paragraph	Page)
		Lesson 3		
19	b	3	1a	64
20	b	3	1b	64
21	d	3	1e	65
22	c	3	1c	65
23	e	3	1d(2)(b)	67
24	b	3	1d	66
25	c	3	2	68

TO ASSEMBLE: CUT DIALS "A" AND "B" ALONG THE HEAVY LINES.
CUT OUT "ASA" WINDOW ON DIAL "A"