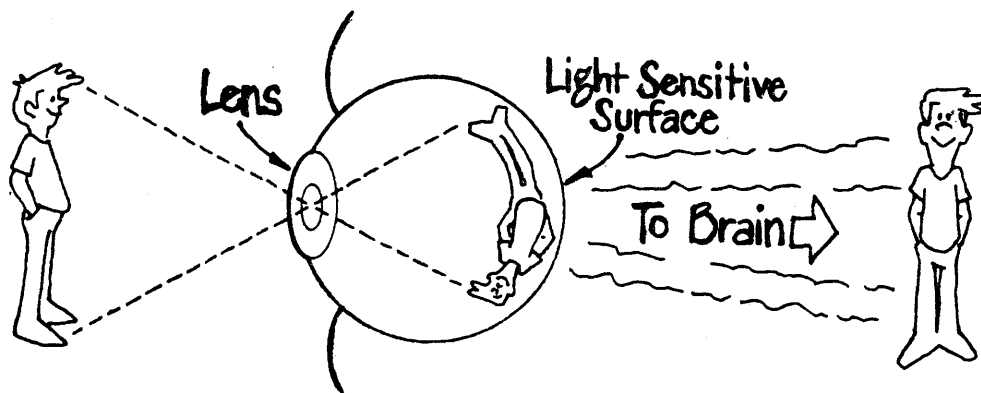


## 1. Basics

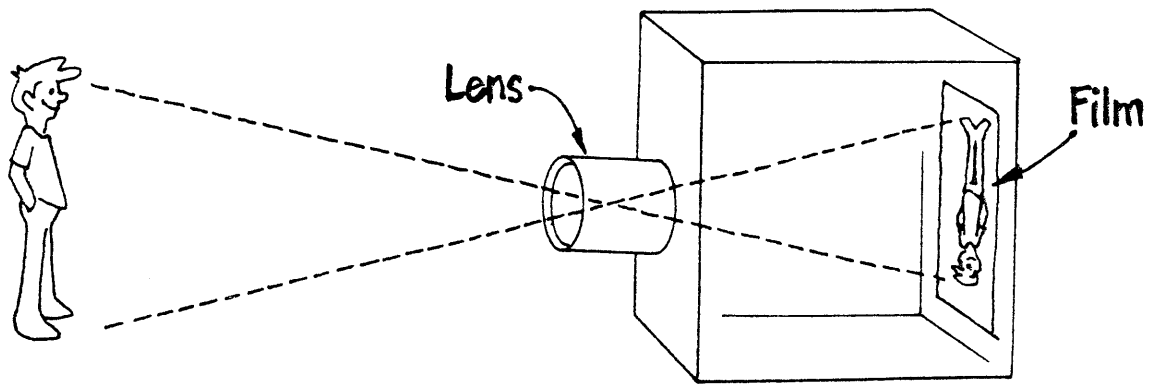
### THE CAMERA - HOW IT WORKS

The camera is an imperfect imitation of the human eye. Like the eye, it sees by means of a lens which gathers light reflected off objects. The lens directs this light onto a surface which senses the pattern formed by the differences in brightness and color of the different parts of the scene. In the case of the eye, this surface at the back of the eye sends the pattern of light to the brain where it is translated into an image which we "see."



*THE EYE GATHERS PATTERNS OF REFLECTED LIGHT WHICH THE BRAIN TRANSLATES INTO IMAGES WE SEE.*

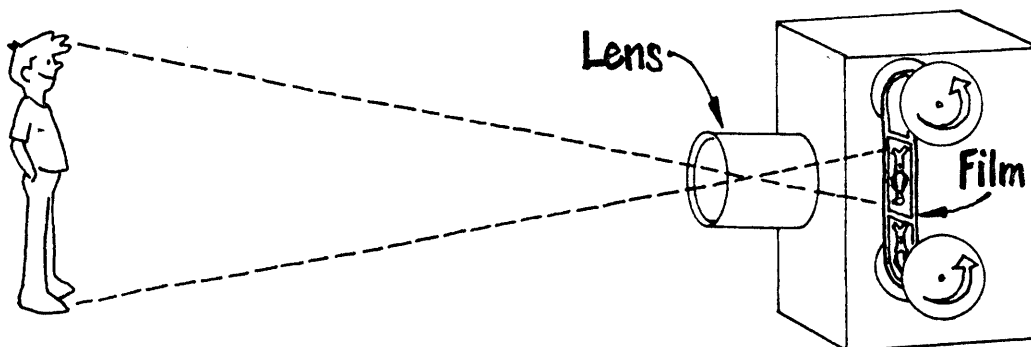
In the case of the camera, the lens directs the patterns of light onto a variety of sensitive surfaces. Still cameras record light patterns on film coated with light-sensitive chemicals. The chemicals react differently to different amounts and colors of light, forming a record, or image of the light pattern. After the film is processed in other chemicals, the image becomes visible.



*STILL CAMERAS RECORD LIGHT PATTERNS ON FILM COATED WITH LIGHT-SENSITIVE CHEMICALS.*

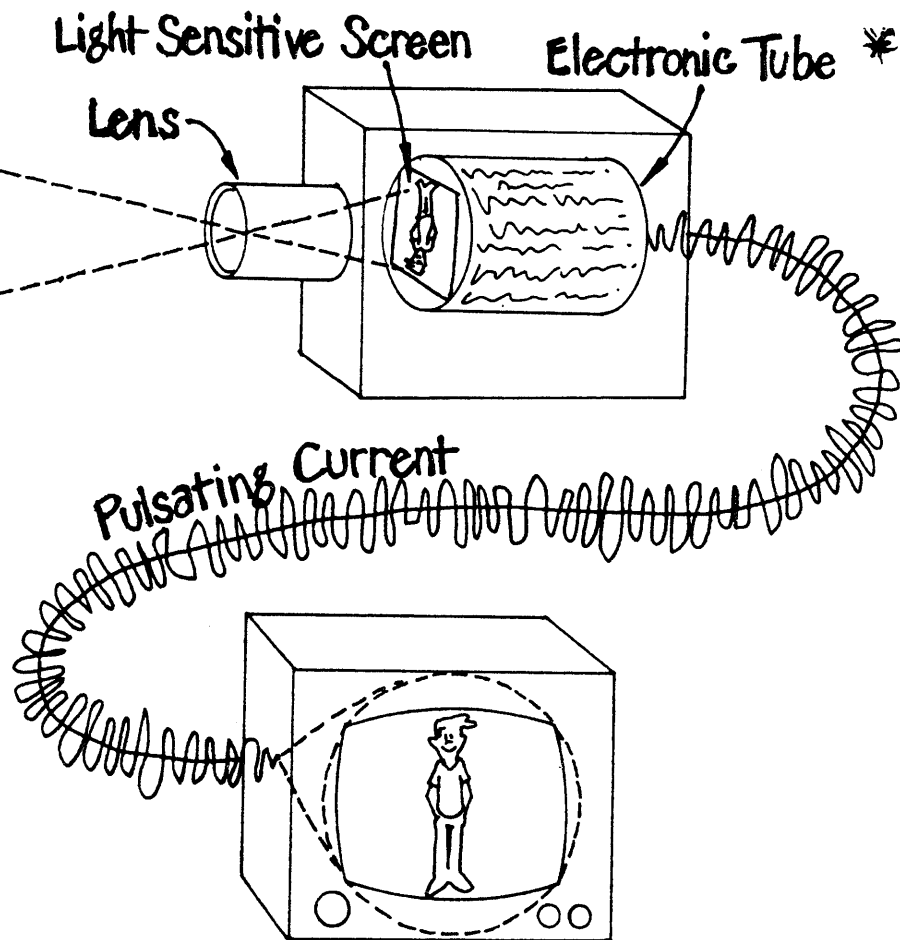
You'll notice that both the lens of the eye and the lens of the camera turn the light pattern upside down as it passes through. This is because they're both convex lenses, or lenses which curve outward. Because of their physical properties, convex lenses always invert images. In the brain, and in the camera viewfinder, the images are turned right side up again.

Movie cameras record images in the same way as still cameras, except they do it more often. Eight-millimeter movie cameras normally take 18 different pictures every second. Sixteen millimeter and thirty-five millimeter movie cameras normally take 24 pictures, or frames, per second. When these pictures are projected on a screen at the same fast rate, they give the illusion of continuous movement. The viewer's mind fills in the gaps between the individual frames, due to a physiological phenomenon known as persistence of vision.



*MOVIE CAMERAS TAKE MANY DIFFERENT PICTURES EVERY SECOND.*

The lens of a television camera focuses light patterns onto the light-sensitive screen of an electronic tube.\* Different parts of the screen give off electrons according to the amount of light hitting them. The electronic images formed by the released electrons are collected off the screen at the rate of thirty complete images per second and converted into a pulsating electric current. At the TV set, this current is converted back again to form an image on the picture tube. As with a movie camera, persistence of vision causes the viewer to perceive the thirty separate pictures per second as continuous movement.



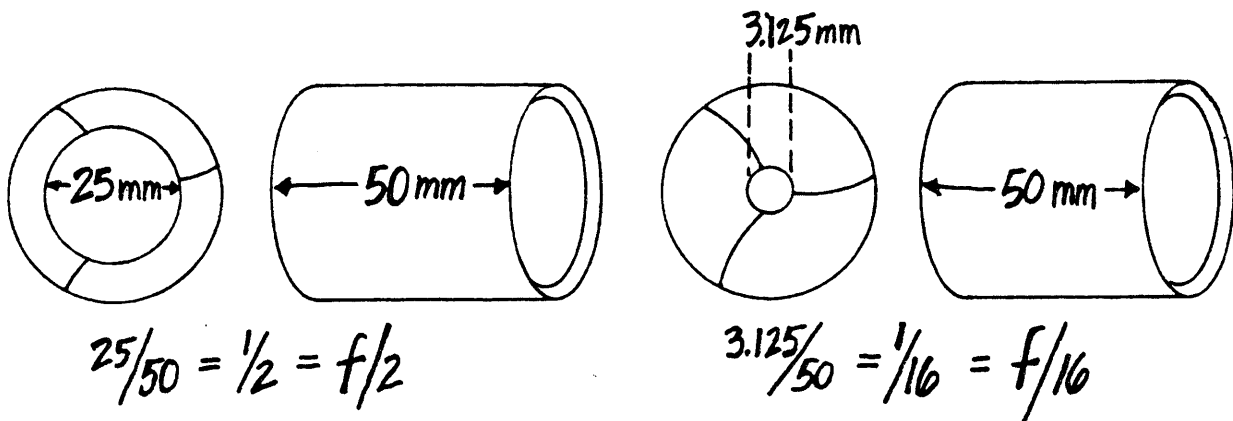
*TV CAMERAS CONVERT LIGHT PATTERNS INTO ELECTRONIC PATTERNS.*

\* In place of tubes, many cameras now use CCD's--charge-coupled devices--small, flat, light-sensitive chips which do the same job.

## EXPOSURE

Exposure is the amount of light that comes through the lens and hits the film, the TV tube, or the CCD chip. The hole in the center of the lens that the light travels through is called the aperture. If the aperture is big, it lets in a lot of light. If it's small, it lets in very little light. The size of the aperture is adjusted by the f/stop ring on the outside of the lens. An f/stop is simply a measure of how big or how little the aperture is.

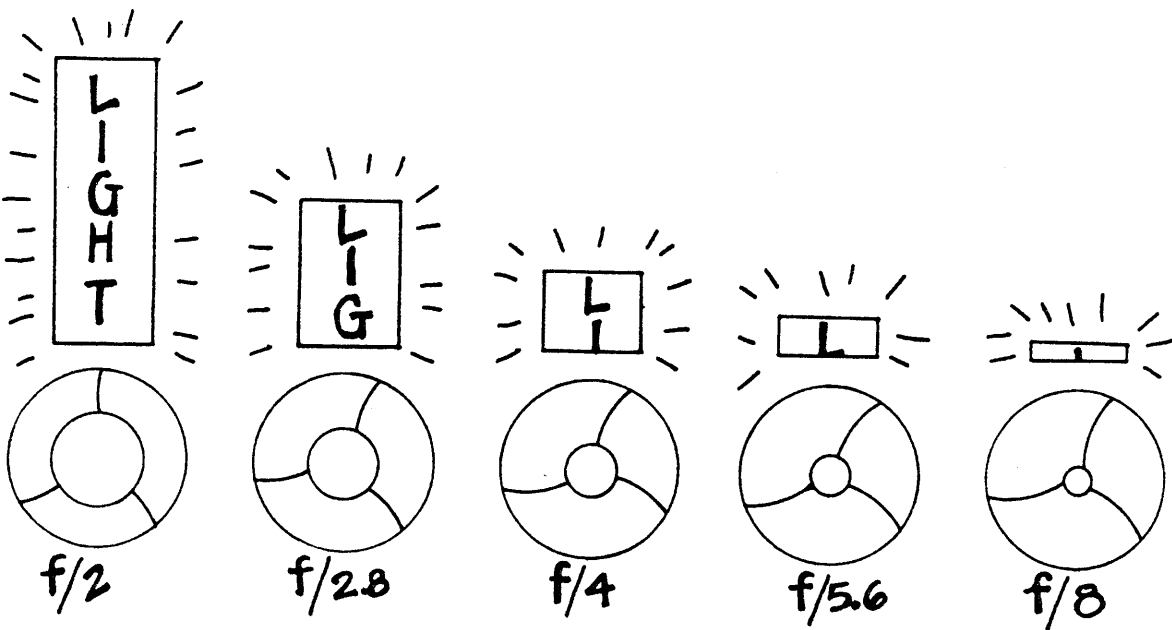
I find that the easiest way to understand f/stops is to think of them in terms of fractions, because that's what they really are. F/2 means that the aperture is 1/2 as big across as the lens is long. F/16 means that the aperture is 1/16 as big across as the lens is long.



When you look at it this way, it's easy to understand why in a dark room, you'll probably be shooting at f/2 to let in all the light you can. Conversely, outside in bright sunlight, where you've got a lot of light, you'll probably stop down to f/11 or f/16, to let less light in.

Now that you understand that, let me point out that in most modern lenses, especially zoom lenses, what I've just told you isn't absolutely true. An  $f/2$  aperture won't physically be exactly  $1/2$  the length of the lens. But optically it will be. It will let through as much light as if it were indeed  $1/2$  the length of the lens. And that's the important thing.

F/stops are constructed so that as you go from  $f/1$  to  $f/22$  and beyond, each stop admits  $1/2$  as much light as the one before. The progression is:  $f/1$ ,  $f/1.4$ ,  $f/2$ ,  $f/2.8$ ,  $f/4$ ,  $f/5.6$ ,  $f/8$ ,  $f/11$ ,  $f/16$ ,  $f/22$ ,  $f/32$ ,  $f/45$ ,  $f/64$ , and so on.  $f/1.4$  admits half as much light as  $f/1$ .  $f/4$  admits half as much light as  $f/2.8$ .



*EACH F/STOP ADMITS HALF AS MUCH LIGHT AS THE ONE BEFORE.*

Many of the newer lenses are marked in both f/stops and T/stops, or T/stops alone. T/stops are more accurately measured f/stops.  $f/4$  on one lens may not let in exactly the same amount of light as  $f/4$  on another lens; but  $T/4$  is the same on every lens. It always lets in the same amount of light.

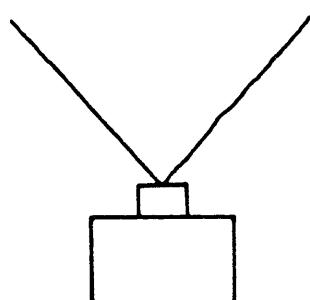
## LENSES

The human eye is a wonder. With a single lens, it can concentrate on a tiny detail of a scene, excluding all else; and in the next instant take in a whole panorama. Unfortunately, the camera is not so versatile. It requires many different lenses to even approximate the performance of the eye.

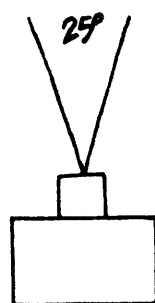
Every camera has one lens which is considered the "normal" lens. This is the lens which comes closest to reproducing objects with the same perspective as the human eye; that is, objects appear to be the same size, proportion and distance as if we weren't looking through the camera at all, but seeing them with the naked eye. The normal lens usually includes a horizontal area of about 25°.

On a sixteen millimeter camera, the normal lens has a focal length (its optical measurement) of 25 millimeters. On a 35-millimeter camera, it's 50 millimeters long. On a video camera with a 2/3" tube or CCD, the normal lens is 25 millimeters long.

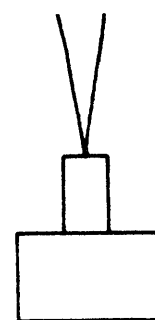
The other lenses on the camera are classified "wide angle" if they include a larger area than the normal lens's 25 degrees, and "telephoto" if they include a smaller area.



**Wide Angle**



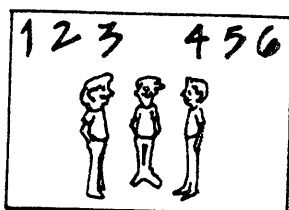
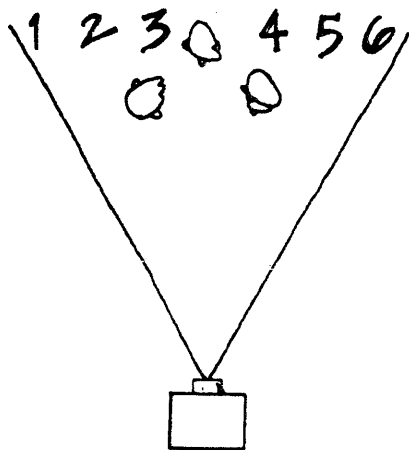
**Normal**



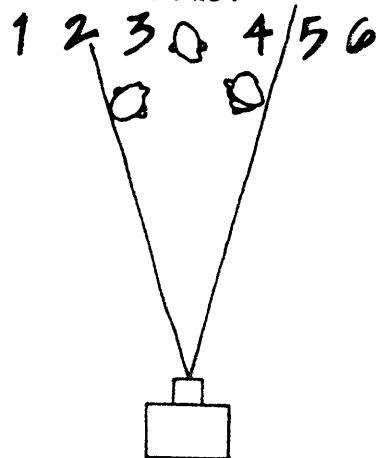
**Telephoto**

Wide angle lenses are shorter than normal lenses; telephoto lenses are longer. If your normal lens is 25mm, your wide angle might be 12mm and your telephoto 100mm.

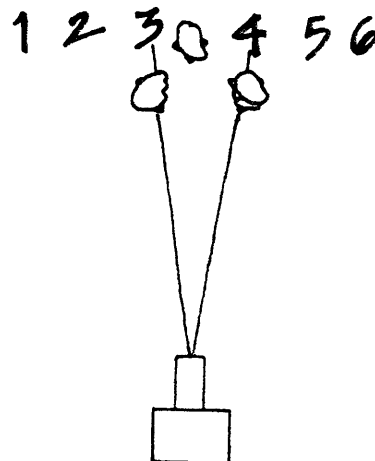
Wide angle and telephoto lenses have special characteristics which can be summarized as follows:



Wide Angle



Normal



Telephoto

- \* Includes a larger area than the normal lens at the same distance--good for cramped quarters where you can't move the camera back any farther.

- \* Subject is smaller in the frame than with the normal lens at the same distance.

- \* Exaggerates depth--makes elements appear farther apart than normal.

- \* Because of exaggerated distances, movements toward and away from the camera seem faster than normal. Move 6 inches toward the camera and it looks like you're moving 18 inches.

- \* Because of smaller image size, camera jiggles are less noticeable. Good for handholding the camera.

- \* Includes a smaller area than the normal lens at the same distance--good for distant subjects where you can't move the camera closer.

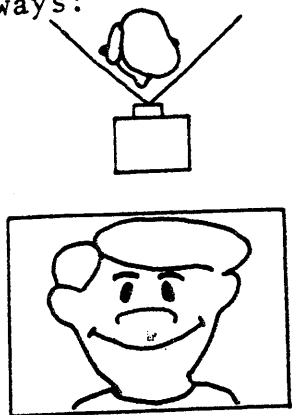
- \* Subject is larger in the frame than with the normal lens at the same distance.

- \* Compresses depth--makes elements appear closer together than normal.

- \* Because of compressed distances, movements toward and away from the camera seem slower than normal. Move 18 inches toward the camera and it looks like you're moving 6 inches.

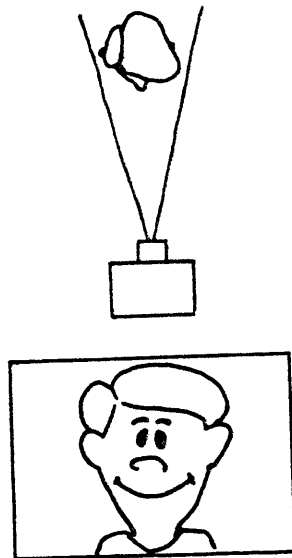
- \* Because of larger image size, camera jiggles are more noticeable. Bad for handholding the camera.

Wide angle and telephoto lenses reproduce faces in different ways:

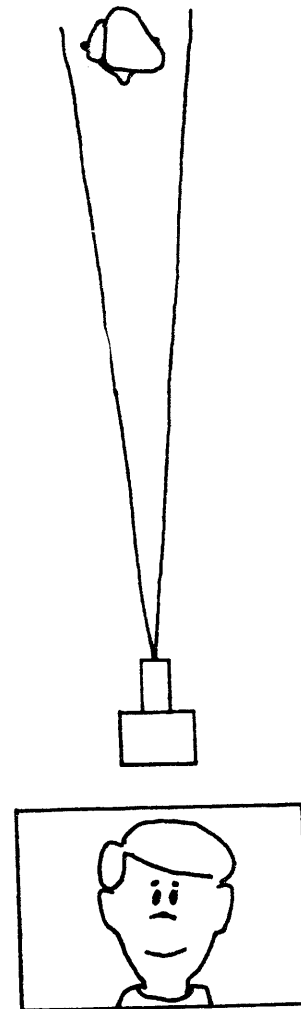


**Wide Angle**

*Features become spread out, bulbous.*



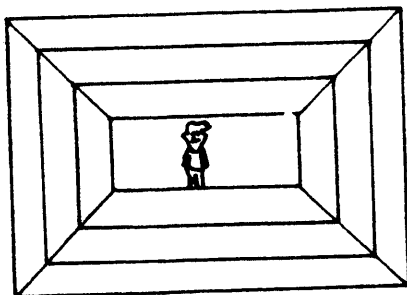
**Normal**



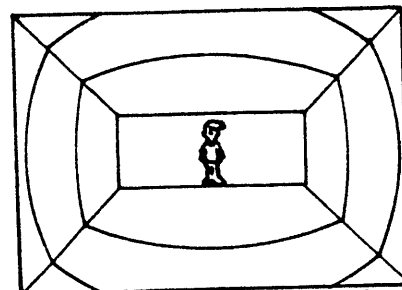
**Telephoto**

*Features become flattened out, compressed.*

The more extreme wide angle lenses suffer from geometric distortion. Vertical and horizontal lines become curved near the edges of the frame.



**Normal**

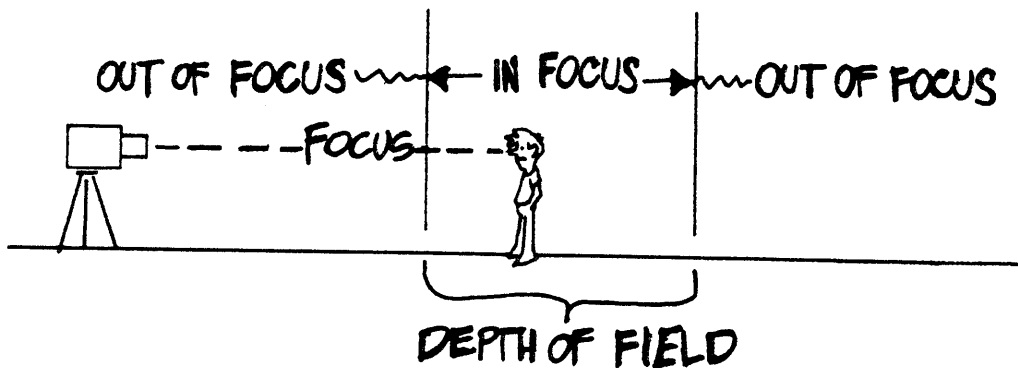


**Extreme Wide Angle**

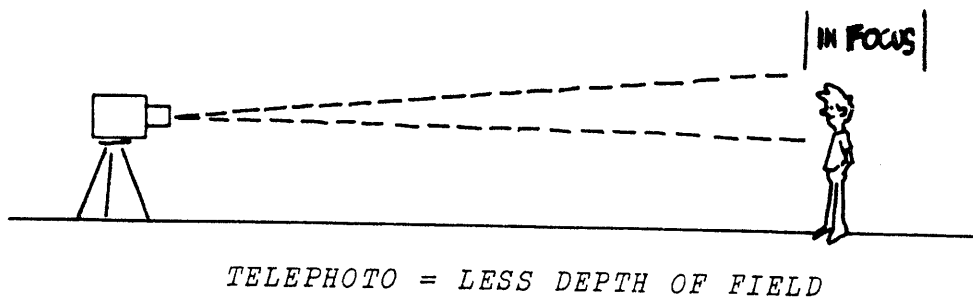


## DEPTH OF FIELD

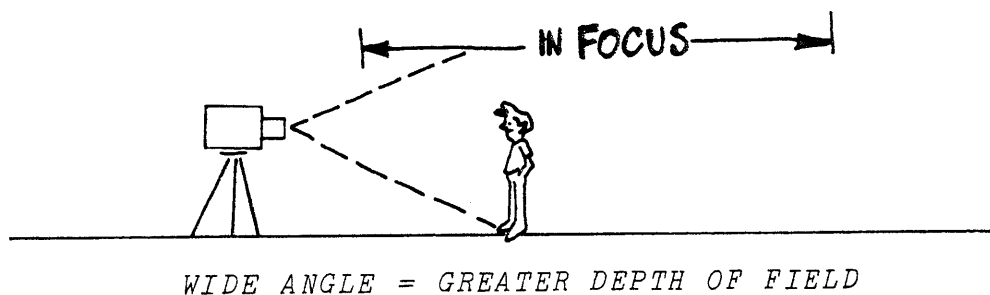
Depth of field is simply the area in front of your camera where everything looks sharp and in focus. For example, if you're focused on somebody standing 10 feet in front of the camera, your depth of field might be from 8 feet to 14 feet. That means objects falling within that area will be acceptably sharp and in focus; objects falling outside the area will be soft and out of focus.



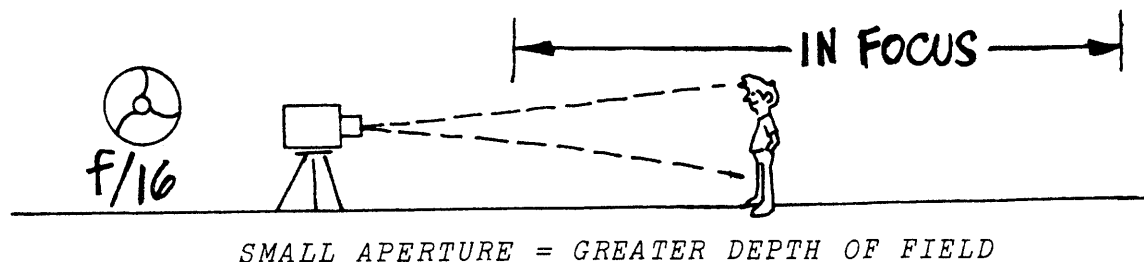
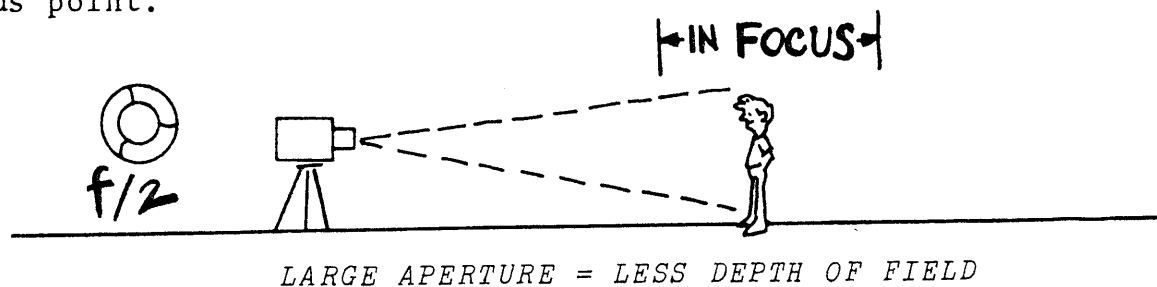
There are several important things to know about depth of field. First is this: Your depth of field decreases as you increase your focal length. In other words, with a telephoto lens you have a much shallower area in focus than with a normal lens. That's why with a zoom lens, you zoom in to telephoto for focusing--it makes it easier to see the exact point where your subject is sharpest.



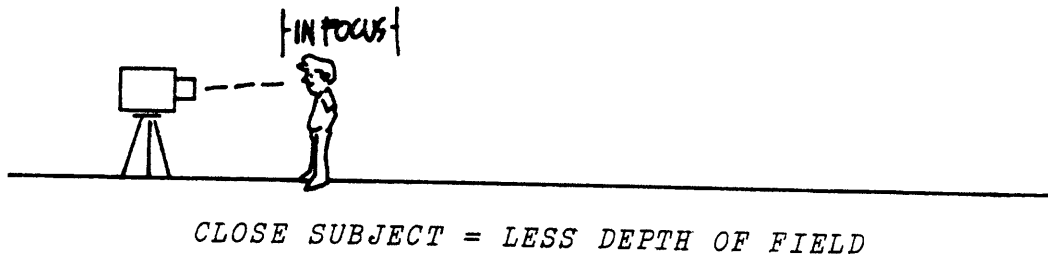
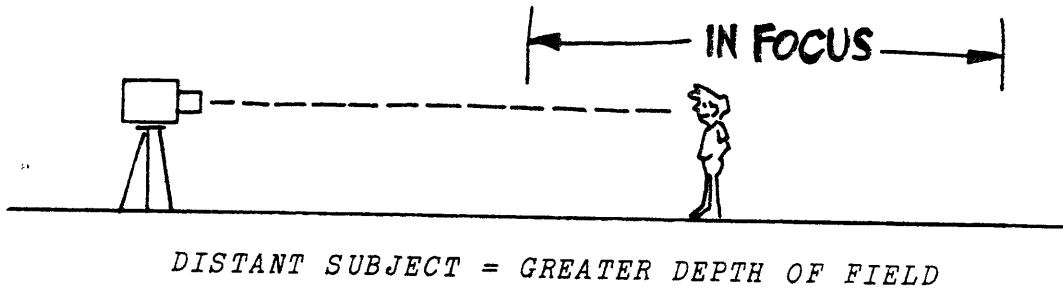
The next thing to know is: Your depth of field increases as you decrease your focal length. With a wide angle lens, you have a much deeper area in focus than with a normal lens. This is why, when you're shooting in uncontrolled situations with a zoom lens and don't have time to zoom in and check focus, you're better off setting an approximate focus and staying at wide angle. This will give you your best chance of keeping everything in acceptable focus.



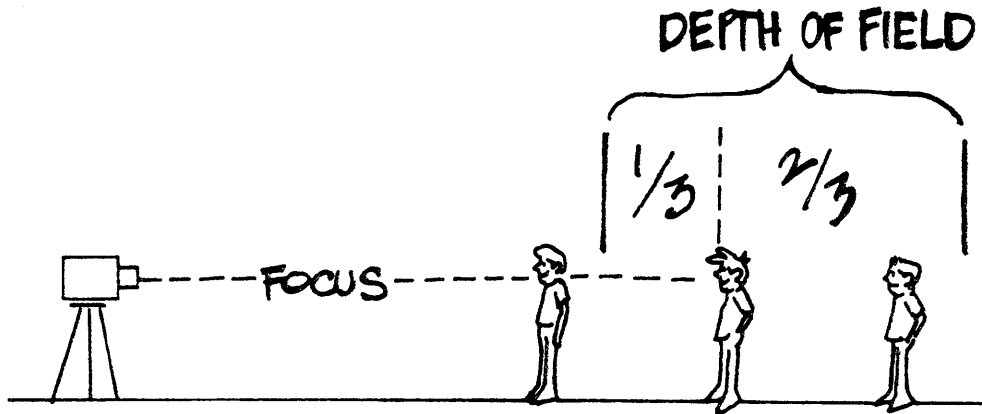
Another thing about depth of field: Your depth of field increases as you close down your aperture. At f/16 you have more depth of field than at f/2. When you make your aperture smaller, it's essentially the same as squinting your eyes to see something sharper in the distance. This is why on film cameras we open the lens to it's widest aperture to focus: it makes it easier to see the exact focus point.



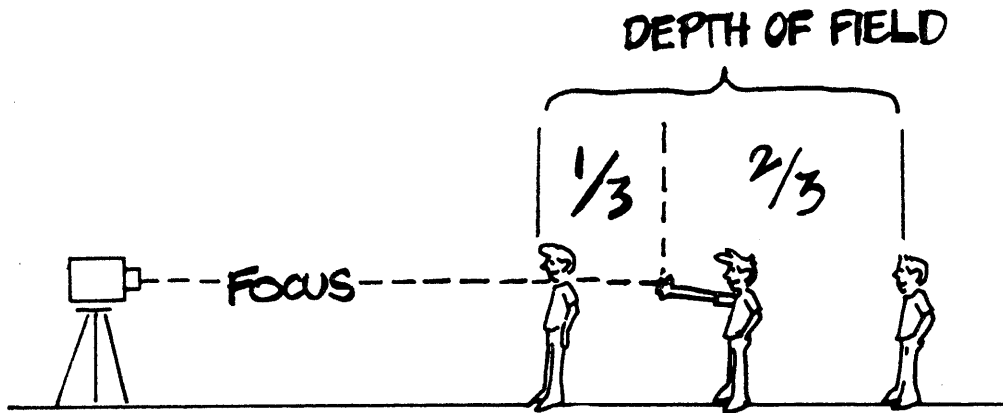
Next: Your depth of field increases as your subject gets farther from the camera. The farther away the subject, the more depth of field; the closer the subject, the less depth of field.



Finally: You always have less depth of field in front of your point of focus than behind it. This is especially noticeable at distances of 25 feet or less. At these near distances, you can usually figure on your depth of field extending approximately 1/3 in front and 2/3 behind your point of focus. So, if you're working with a shallow depth of field and you want to take maximum advantage of it, focus on a point 1/3 of the way into the area you want in focus.



*FOCUSING IN THE MIDDLE LEAVES THE FRONT MAN OUT OF FOCUS.*

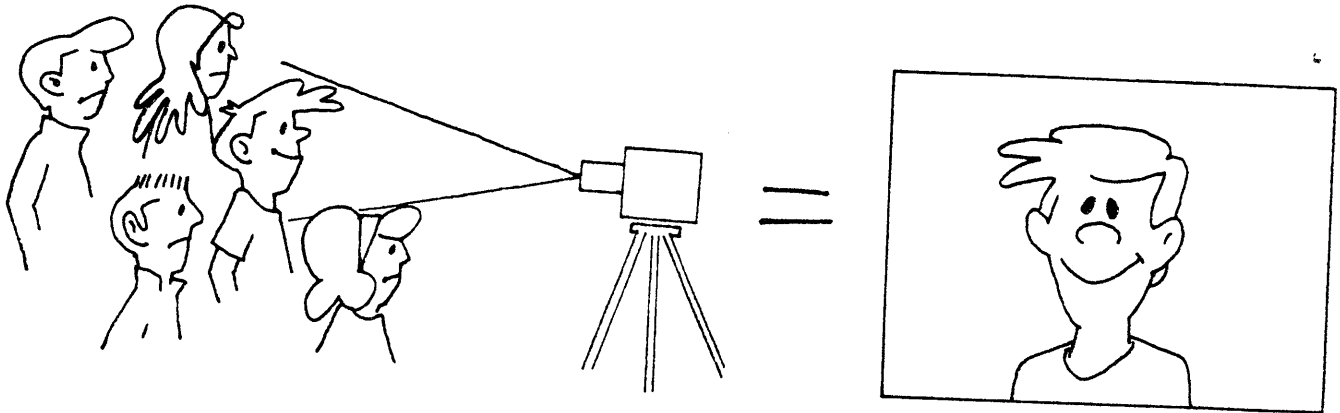


*FOCUSING ON A POINT 1/3 OF THE WAY IN PUTS EVERYBODY IN FOCUS.*

## 2. COMPOSITION

### THE CAMERA - A TOOL FOR SELECTIVE VISION

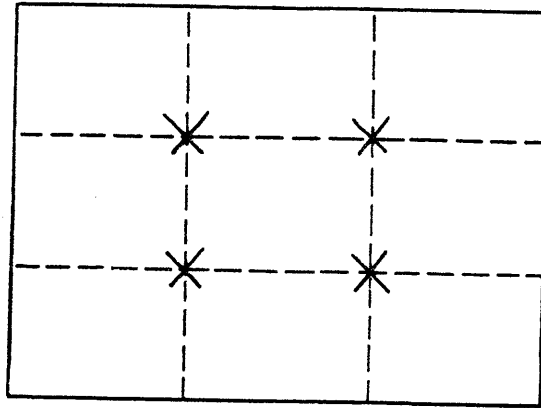
The camera is a tool for looking at things in a special way. It's a window on the world which you control. Your viewer--the person who will look at the pictures you take--will see only what you decide to show him. This selectivity is the basis of all camerawork.



*THE CAMERA IS SELECTIVE. YOU DECIDE WHAT THE VIEWER WILL SEE*

Say you're shooting a program about a high school. The decisions you as a cameraperson make will shape the reality of the school as perceived by your viewer. Leave Student A out of your frame and for your viewer he will never exist. Include B, C, and D in a number of shots and they become important persons. Show E studying by himself and he becomes a loner. By choosing what to shoot and how to shoot it, you create your own selective version of the high school. How close your version comes to reality depends on your camera skills and how you use them.

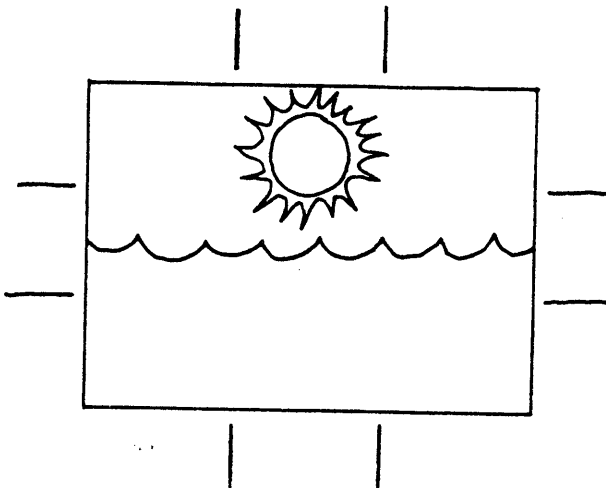
## RULE OF THIRDS



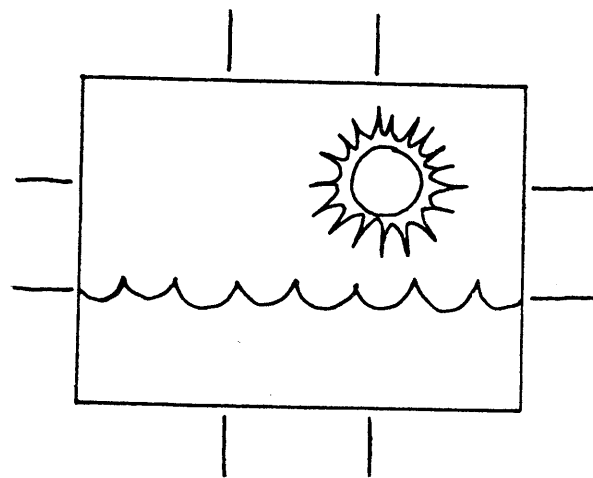
The rule of thirds is an old, old theory about composition that still works pretty well. It won't compose the picture for you, but it'll at least give you someplace to start.

The idea is to mentally divide the frame into thirds horizontally and vertically. Then you place your elements along the lines, preferably with the center of interest at one of the four points where the lines cross.

Here are some examples of compositions improved by using the rule of thirds:



WITHOUT RULE OF THIRDS



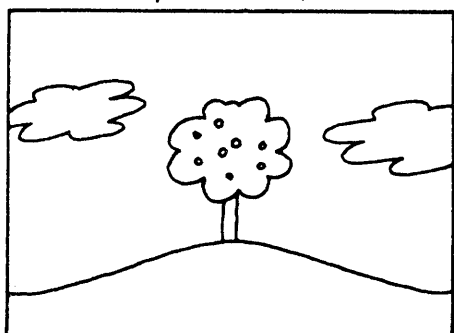
WITH RULE OF THIRDS



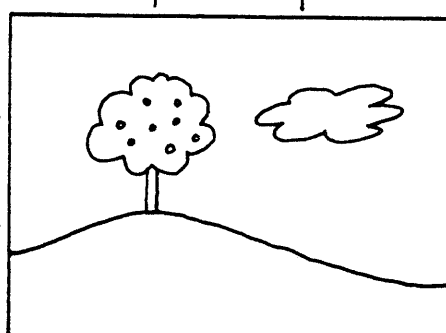
WITHOUT RULE OF THIRDS



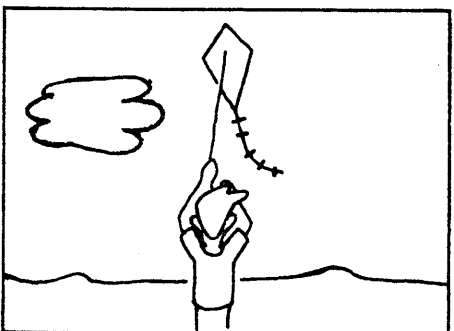
WITH RULE OF THIRDS



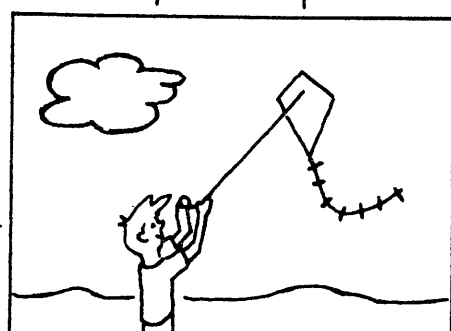
WITHOUT RULE OF THIRDS



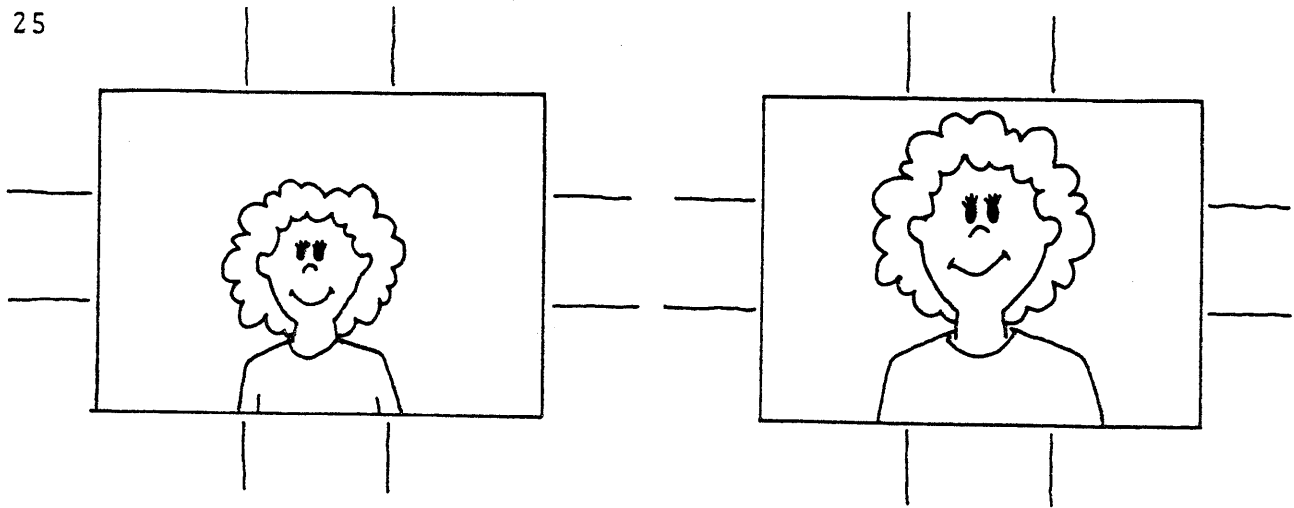
WITH RULE OF THIRDS



WITHOUT RULE OF THIRDS



WITH RULE OF THIRDS



*WITHOUT RULE OF THIRDS*

*WITH RULE OF THIRDS  
(Eyes on top 1/3 line)*

In paintings, still photos and feature films, you'll see many interesting and good compositions that don't comply with the rule of thirds. But remember, such compositions, being more complicated, require more time from the viewer to comprehend. His eye will roam around more before he sees what you want him to see. If you can afford to leave an unusual composition on the screen 15 or 20 seconds or more, it can work--often quite nicely. But be sure you know what you're doing and why. For most documentary film and TV work, the rule of thirds is a good safe bet.



## BALANCE - LEADING LOOKS

One of the most common errors among camerapersons everywhere is the failure to leave enough space in front of people's faces when they're looking to one side or the other.

A shot like this,



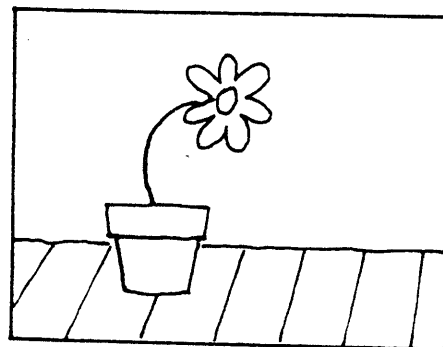
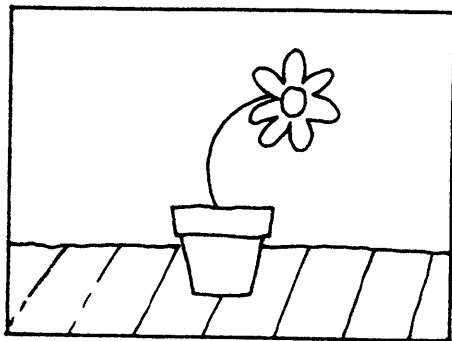
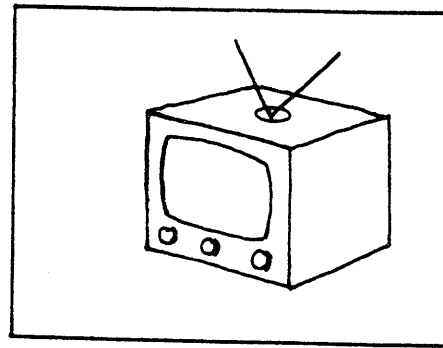
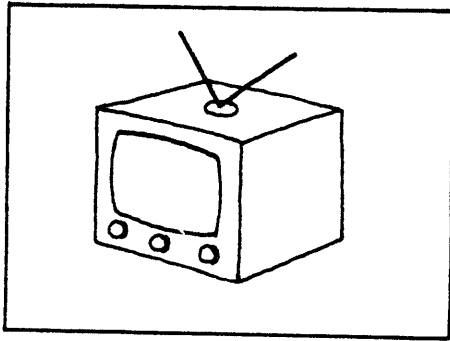
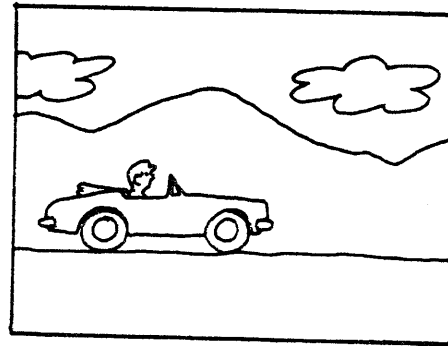
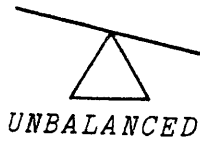
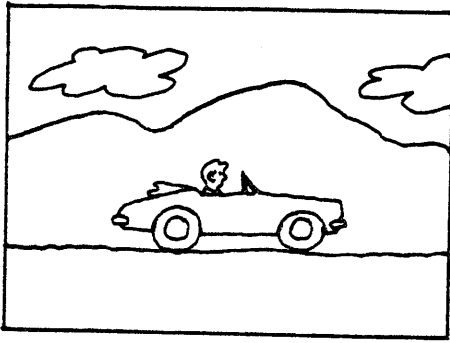
is annoying to look at. Psychologically, the viewer perceives the man as boxed in, with no place to go. By moving the frame just a little, "like this,



you get a more comfortable composition. You've allowed for the compositional weight of the look.

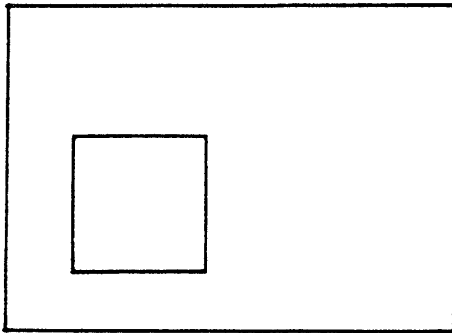
People aren't the only things that have looks. Almost everything has a look. Some examples follow on the next page.

LEADING LOOKS - CONTINUED

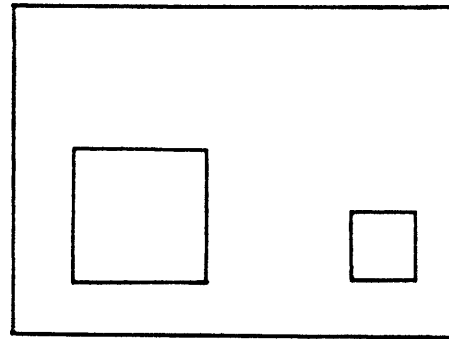


## BALANCE - MASSES

Sometimes you see a scene with a large object on one side and nothing significant on the other side. Even though it doesn't look all that bad, you still feel a little uneasy about it. That's because it's off balance in terms of mass. This is most pleasantly corrected by placing a smaller object at some distance away within the frame. Visual leverage then balances the two nicely, like this:

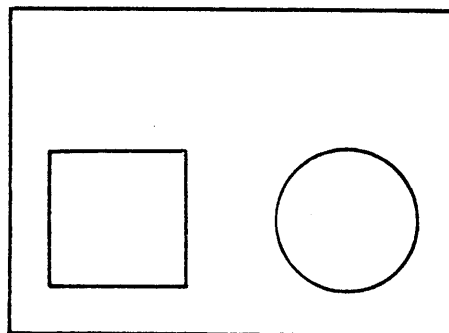


UNBALANCED



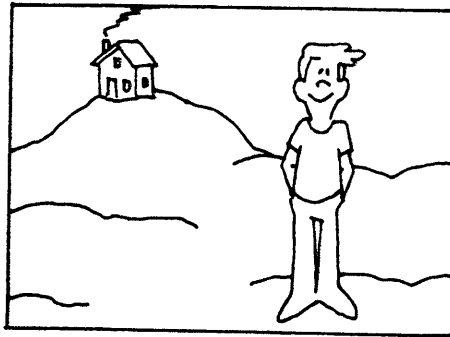
BALANCED

Of course you can balance out with another object the same size in the frame, but it usually ends up kind of static and unexciting:

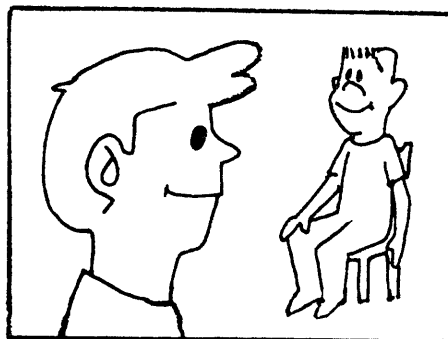
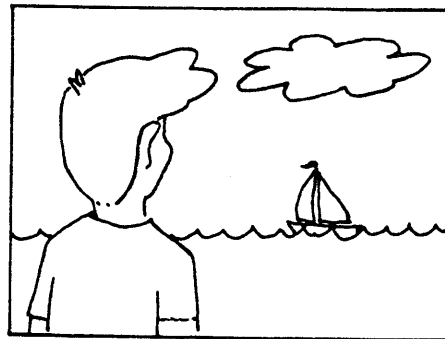
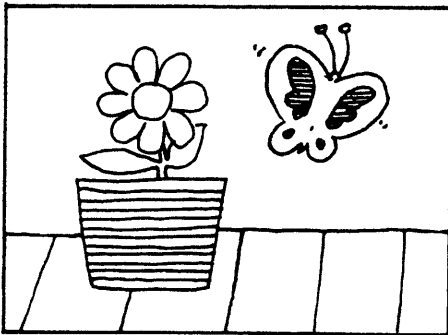


BALANCED

Remember, when we're balancing masses we're not concerned with the true size of things. All that matters is how big they look through the camera. Objects closer to the camera will always appear larger; those farther away will appear smaller. Depending on the camera angle, a house in the distance can balance out a man in the foreground:



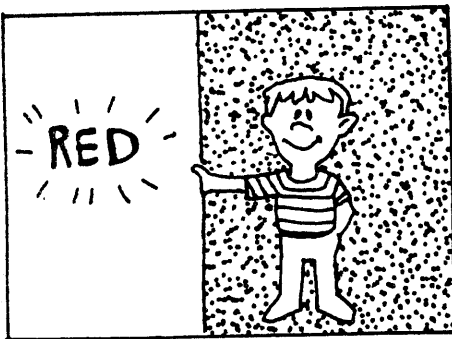
Some other examples:



## BALANCE - COLORS

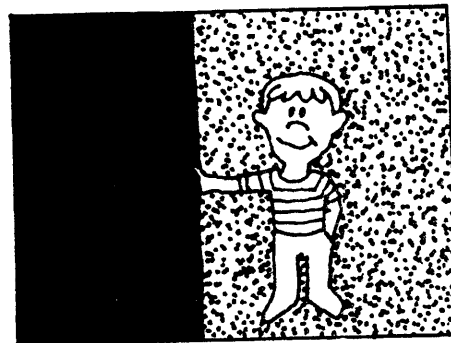
The most important thing to know about colors is that bright ones attract the viewer's eye. How often have you seen a TV interview on location somewhere and found yourself watching, not the interview, but some guy in a red shirt in the background? Your eye just naturally goes to white or brightly colored areas in the frame. Once you know this fact, you can use it to help your pictures.

First off, try to arrange your frame so that the brightest area is also the area you want the viewer to look at first. Consider the following example, where we want the viewer to look at the man:



NO GOOD

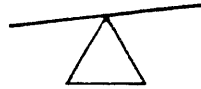
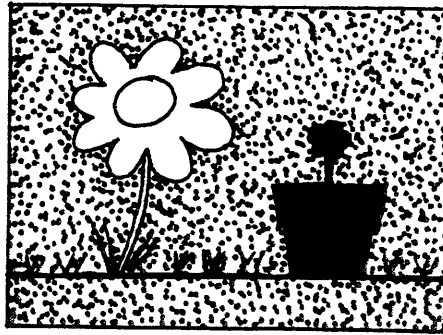
EYE GOES TO THE WALL INSTEAD OF  
THE MAN



BETTER

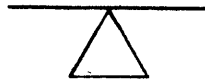
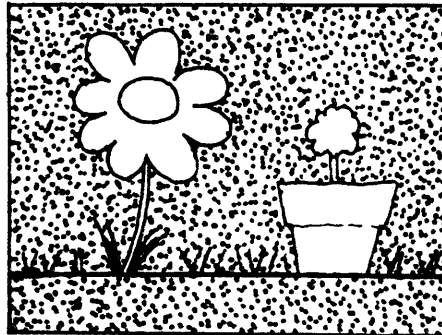
EYE GOES TO THE MAN

When you do include a bright object or area in your frame, remember that its brightness gives it extra weight in the composition--weight you have to balance out, either with another bright area, or with a larger mass.



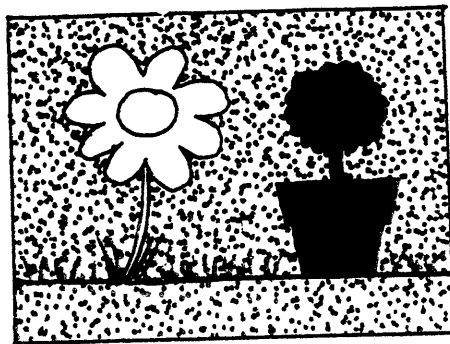
*OFF-BALANCE*

Although the masses of the flower and the pot balance out, the brightness of the flower pulls the composition to the left.



*BALANCED*

The brightness of the pot now balances out the brightness of the flower.

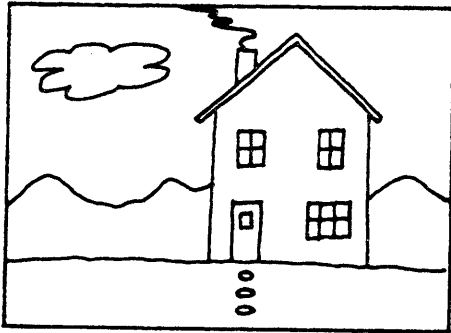
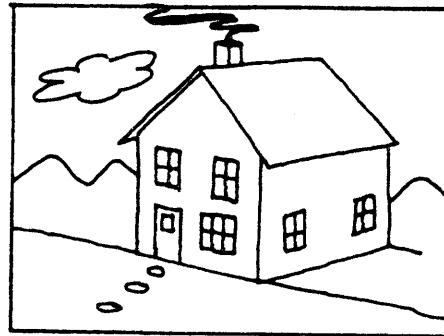


*BALANCED*

Here the brightness of the flower is balanced out by placing a larger mass on the other side of the frame.

## ANGLES

Reality has three physical dimensions: height, width, and depth. In pictures we have only two dimensions: height and width. To give the illusion of depth, we show things at an angle, so we can at least see two sides.

*FLAT**ANGLED**FLAT**ANGLED*

The angle created by the difference in height between the camera and the subject makes a definite impression on the viewer: