Developing the Negative

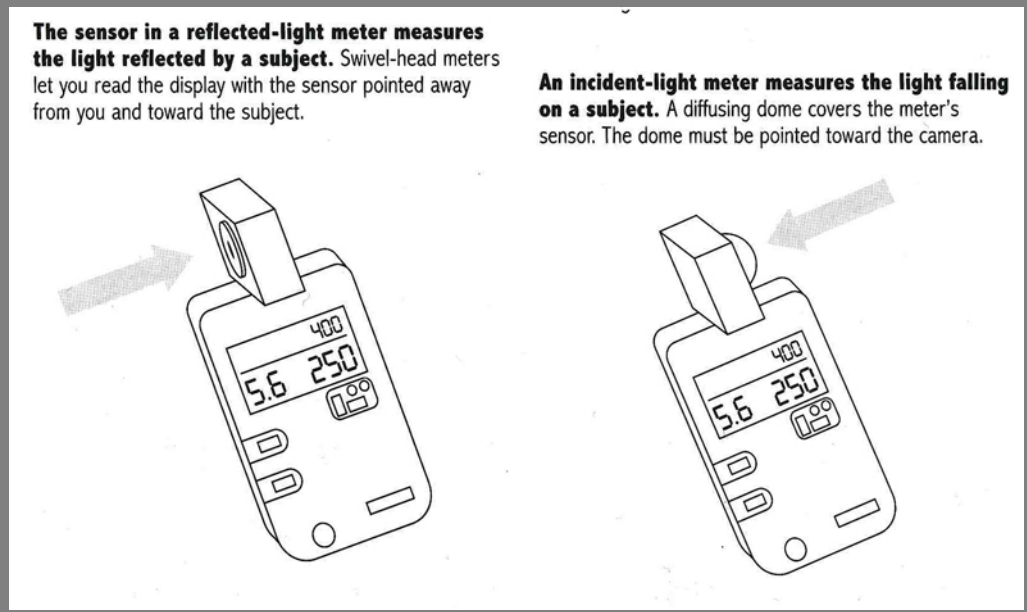
Review

- What are the 2 types of meters?

Review

Reflected Light Meter
•Measures light reflected by the subject

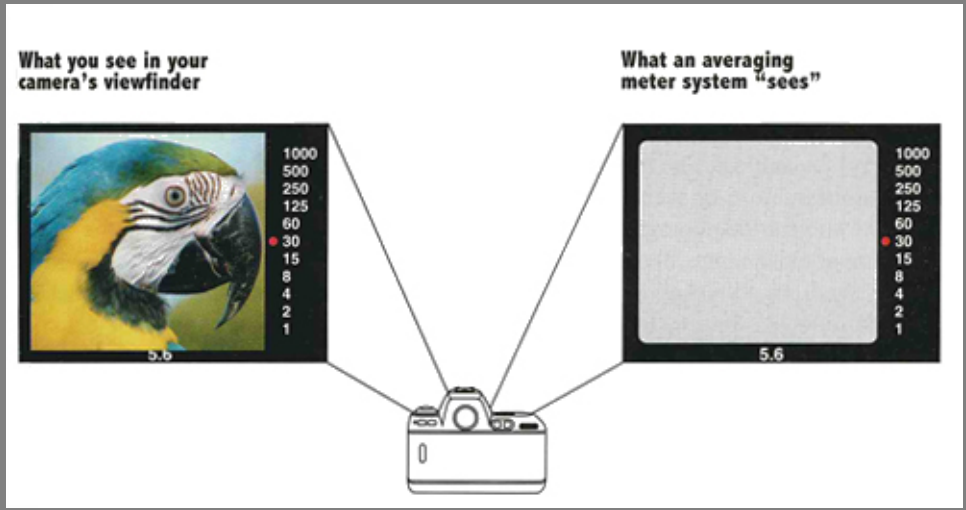
Incident Light Meter
•Measures light falling on the subject



Review

- What do all light meters tell you?
- What do meters see as opposed to what the human eye sees?

Review



All gray meters do the same thing: they average light within the viewing angle of the meter, and give you a proper exposure for 18% middle gray (zone v).

Review

- If you took a meter reading of a white bear, a black gorilla, or a gray elephant, and made an exposure from the settings the meter gave you, what tone would the bear, gorilla, and elephant be?

Review

- If you took a meter reading off a white bear, a black gorilla, or a gray elephant, and made an exposure from the settings the meter gave you, what tone would the bear, gorilla, and elephant be?

All would be 18% middle gray.

- What would you do to make a white bear white?

Review

- If you took a meter reading of a white bear, a black gorilla, or a gray elephant, and made an exposure from the settings the meter gave you, what tone would the bear, gorilla, and elephant be?

All would be 18% middle gray.

- What would you do to make a white bear white?

Open up 2 stops.

- What would you do to make a black gorilla black?

Review

- If you took a meter reading of a white bear, a black gorilla, or a gray elephant, and made an exposure from the settings the meter gave you, what tone would the bear, gorilla, and elephant be?

All would be 18% middle gray.

- What would you do to make a white bear white?

Open up 2 stops.

- What would you do to make a black gorilla black?

Close down 2 stops.

Review
Light meters expose for middle gray

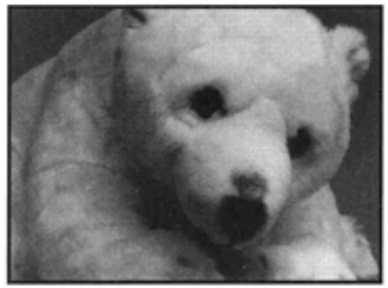
How to expose black-and-white film for specific tones. If one area in a scene is particularly important, you can meter it, then find the exposure that will render that area as dark or as light as you want it to be in the final print.

Five stops more exposure than indicated by meter. Maximum white of the paper base. Whites without texture, glaring white surfaces, light sources.	
Four stops more exposure. Near white. Slight tonality but no visible texture. Snow in flat sunlight.	
Three stops more exposure. Very light gray. Highlights with first sign of texture, bright cement, textured snow, brightest highlights on light skin.	
Two stops more exposure. Light gray. Very light surfaces with full texture and detail, very light skin, sand or snow acutely sidelit.	
One stop more exposure. Medium-light gray. Lit side of average light-toned skin, shadows on snow in a scene with both shaded and sunlit snow.	
Exposure indicated by meter. Middle gray. The tone that a reflected-light meter assumes it is reading. Neutral gray test card, dark skin, clear north sky.	
One stop less exposure. Medium-dark gray. Dark stone, average dark foliage, shadows in landscape scenes, shadows on skin in sunlit portrait.	
Two stops less exposure. Dark gray. Shadows with full texture and detail, very dark soil, very dark fabrics with full texture.	
Three stops less exposure. Gray-black. Darkest gray in which some suggestion of texture and detail appears.	
Four stops less exposure. Near black. First step above complete black in the print, slight tonality but no visible texture.	
Five stops less exposure than indicated by meter. Maximum black that paper can produce. Doorway or window opening to unlit building interior.	

Exposure to make a white bear white.

Metered frame

Exposure to make a Black gorilla black.



White polar bear given exposure suggested by meter

White polar bear given 2 stops more exposure

Gray elephant given exposure suggested by meter

Black gorilla given exposure suggested by meter

Black gorilla given 2 stops less exposure

Review

- How do you bracket?

How to Bracket

Bracketing produces lighter and darker versions of the same scene and helps if you are not sure about the exposure. To bracket, make several exposures of the same scene, increasing and decreasing the exposure by adjusting the aperture, shutter speed, or both. Among several different exposures, there should be at least one that is correct. Professional photographers often bracket as protection against having to repeat a whole shooting session because none of their exposures was quite right. Bracketing is particularly useful when shooting transparency film, which has a very narrow exposure latitude.

To bracket by one stop, first make an exposure with the aperture and shutter speed set at the combination you think is the right one or set by the automatic system. Then make a second shot with one stop more exposure and a third with one stop less exposure. In some situations you might want to bracket even more, giving two stops more exposure and two stops less.

Bracketing is easy if you set the exposure manually. For one stop more exposure, either set the shutter to the next slower speed or the aperture to the next larger opening (the next smaller f-number). For one stop less exposure, either set the shutter to the next faster speed or the aperture to the next smaller opening (the next larger f-number).

NOTE: Bracketing is not always simple with an automatic exposure camera. In automatic operation, if you change to the next larger aperture, the camera will simply shift to the next faster shutter speed, resulting in the same overall exposure. Some cameras have features that override automatic exposure in order to provide bracketing. Other automatic cameras allow you to select a mode that automatically brackets for you. See page 97 for various means of overriding a camera's automatic system. See your manufacturer's instruction book for how to do so with your particular camera.

HOW TO BRACKET



Suppose an exposure for a scene is 1/60 sec shutter speed at f/5.6 aperture. Using any one of the combinations below will give exactly the same exposure:

Shutter speed	1/8	1/15	1/30	1/60	1/125	1/250 sec
Aperture	f/16	f/11	f/8	f/5.6	f/4	f/2.8

Bracketing for one stop less exposure. To lighten a negative (darken a slide) by giving one stop less exposure, use the next smaller aperture:

1/60
f/5.6 → f/8

or the next faster shutter speed.

1/60 → 1/125
f/5.6

Bracketing for one stop more exposure. To darken a negative (lighten a slide) by giving one stop more exposure, use the next larger aperture:

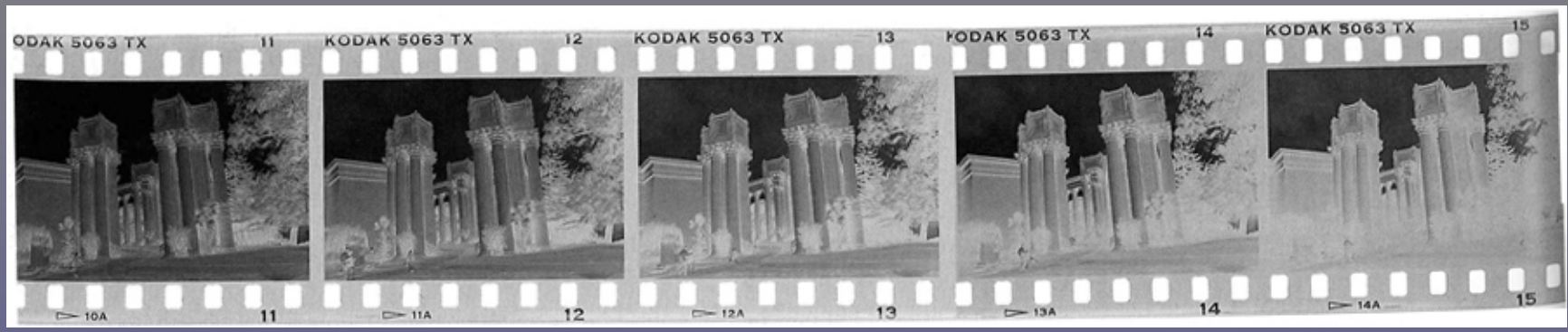
1/60
f/4 ← f/5.6

or the next slower shutter speed.

1/30 ← 1/60
f/5.6

Negative Exposure

Each image from left to right received one stop less light

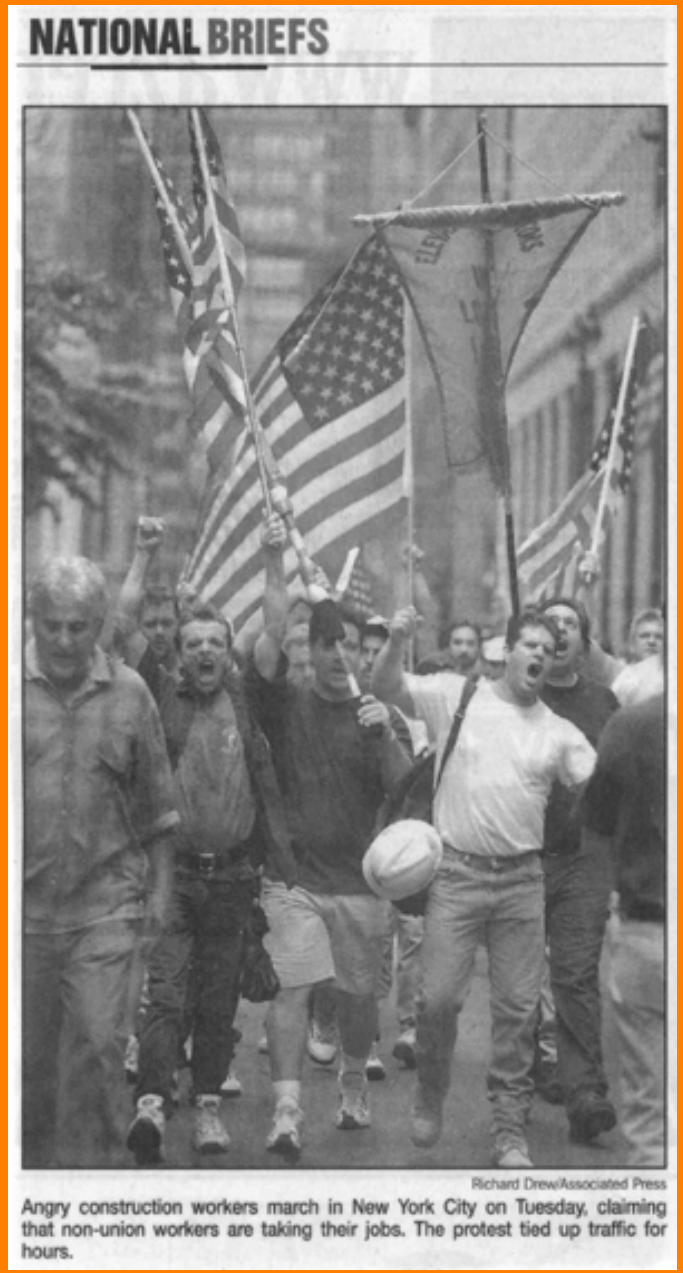


+ 2 stop **+ 1 stop** **Metered Frame** **- 1 stop** **- 2 stops**

Areas that appear dark in the negative will print as white. Areas that are clear in the negative will print as black.
Bracketing your exposures (giving more and less exposure in addition to the metered frame will give a choice of negatives.

warm ups

Photo Detective



- Lens used?

Wide angle, normal, telephoto

- Type of Light?

Sun, Sky, Artificial.
Direction of: front (axis), side, overhead, back.
Quality of: soft/diffused, contrasty / harsh

- Aperture - f/stop used?

Large or small

- Shutter Speed used?

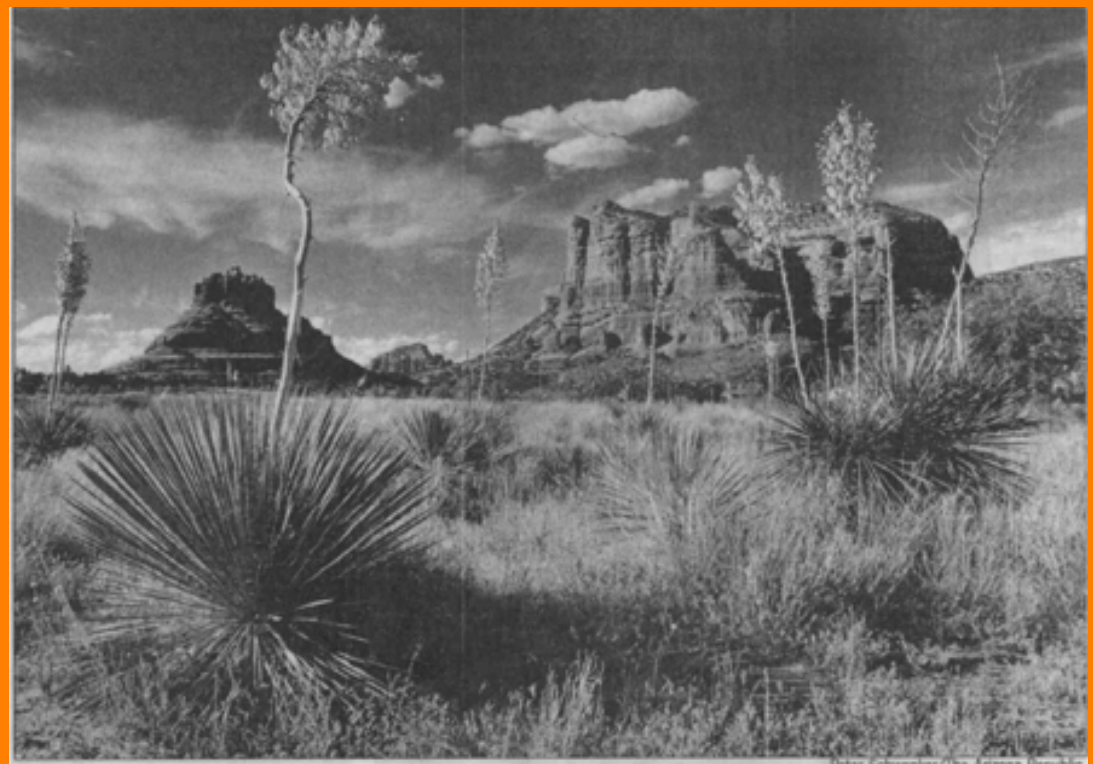
Fast or Slow

- Depth of Field?

Great or shallow

warm ups

Photo Detective



Peter Schwepker/The Arizona Republic

Yucca plants adorn the landscape near Bell Rock in Sedona. So many blooms together is what caught my attention when I took this photo several springs ago. But translating this colorful scene onto black and white film was a challenge. I used an orange filter over a 28mm lens and underdeveloped the Kodak Tri-X film to translate the dramatic scene of the clouds and yucca against Bell Rock. Yuccas begin blooming in late May in this part of the state.

- Lens used?

Wide angle, normal, telephoto

- Type of Light?

Sun, Sky, Artificial.
Direction of: front (axis), side, overhead, back.
Quality of: soft/diffused, contrasty / harsh

- Aperture - f/stop used?

Large or small

- Shutter Speed used?

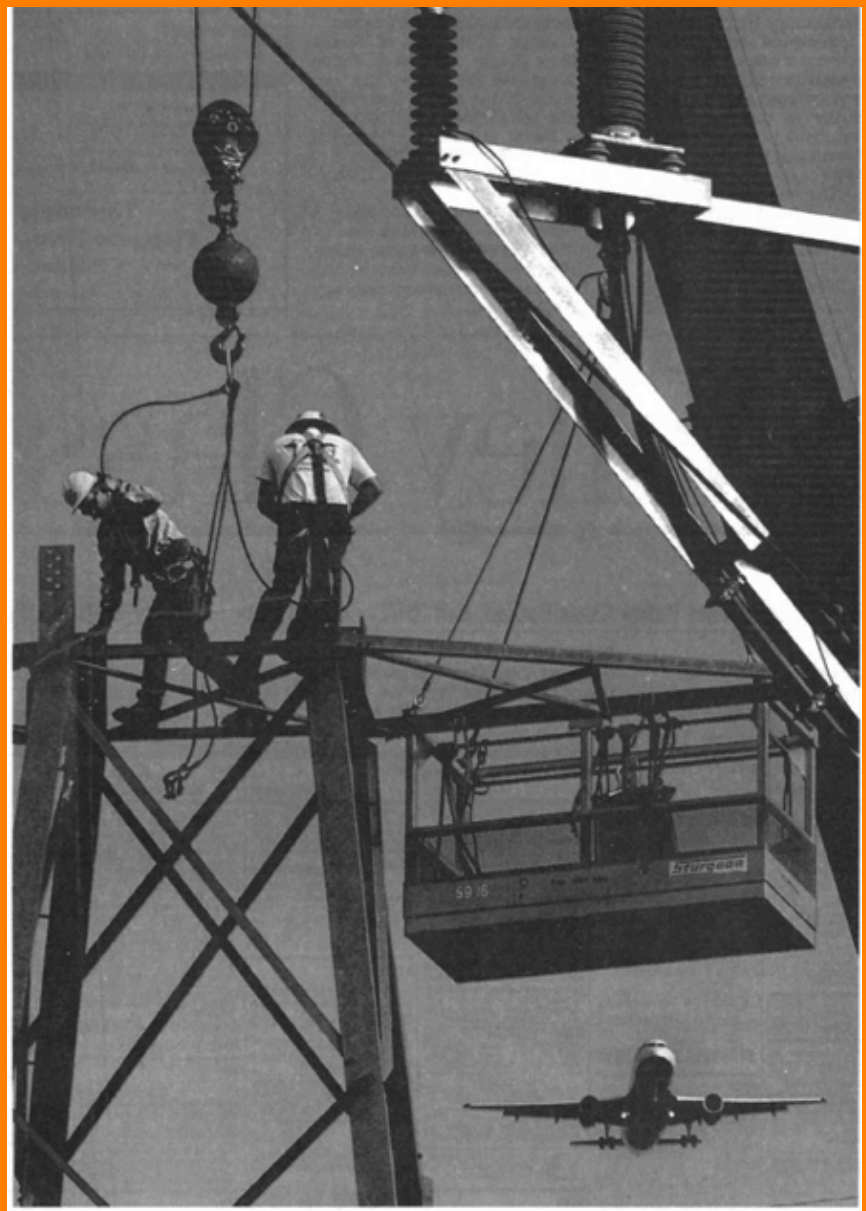
Fast or Slow

- Depth of Field?

Great or shallow

warm ups

Photo Detective



Emmanuel Lozano/The Arizona Republic

Tower advises to come left to runway 1-niner

- Lens used?

Wide angle, normal, telephoto

- Type of Light?

Sun, Sky, Artificial.
Direction of: front (axis), side, overhead, back.
Quality of: soft/diffused, contrasty / harsh

- Aperture - f/stop used?

Large or small

- Shutter Speed used?

Fast or Slow

- Depth of Field?

Great or shallow

Thoughts on Texture

If a photograph conveys the conviction of texture, it will usually convey the impression and substance of light.

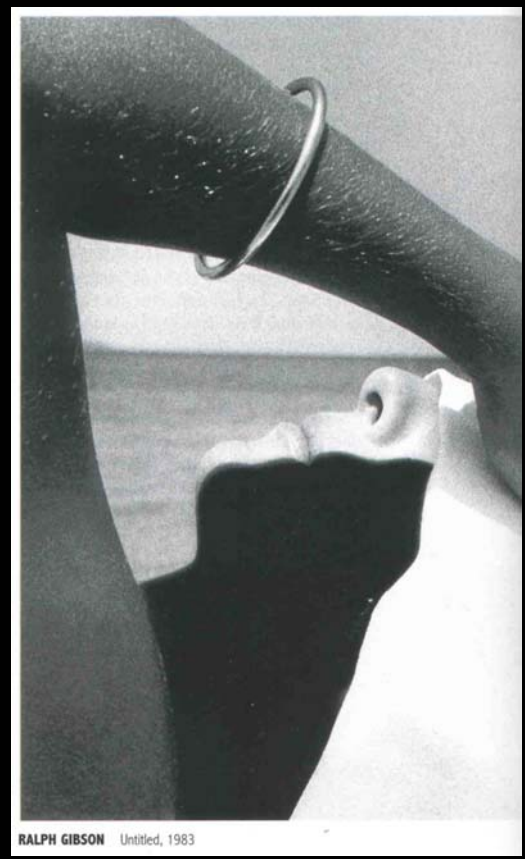
In a photograph one cannot feel detail with the fingers, bu texture is appreciated by both touch, and vision.

Photographic Descriptive Terms

- Flat: A scene, negative, or print with very little difference in brightness between light and dark areas.
- No real black or whites.
- Weak blacks, gray whites, will have a variety of middle tones.

Photographic Descriptive Terms

- Contrasty: A scene, negative, or print with very great differences in brightness between light and dark areas. No middle tones.



Density & Contrast

- Density: The relative amount of silver present in various areas of film or paper after development; therefore, the darkness of a photographic print or the light-stopping ability of a negative.

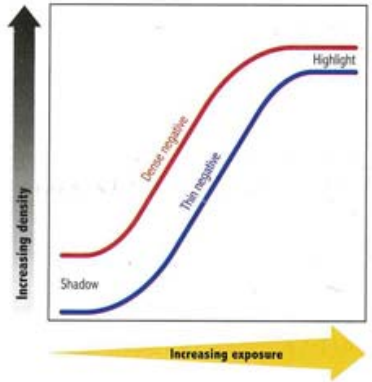
A negative with normal density and contrast. Good separation of tones in highlights, midtones, and shadows (with a scene of normal contrast). Prints well on normal-contrast (#2) paper, or on variable-contrast paper with no printing filter. Grain is normal for the film.

A thin negative has little or no detail in shadow areas and somewhat low contrast overall. Printing times will be short.

Negatives that are thin overall were probably underexposed. If your negatives are often thin, increase exposure by setting a lower film speed (divide film speed by two to increase exposure one stop).

A dense negative has dense highlights and more than adequate density in shadows. Grain increases, and printing times will be long.

Negatives that are dense overall were probably overexposed. If your negatives are often dense, decrease exposure by setting a higher film speed (multiply film speed by two to decrease exposure one stop).

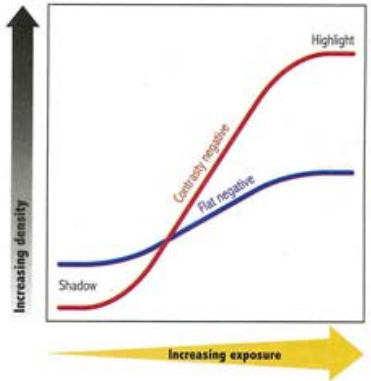


A contrasty or high-contrast negative has a great deal of difference between highlights and shadows. Highlights are very dense, shadows very thin. Grain increases. To get a normal-looking print from a high-contrast negative, print it on a low-contrast (#1 or lower) paper or use a low-contrast printing filter (start with #1, for example).

High contrast results from high contrast in the original scene or from overdeveloping the film. If your negatives are often contrasty, decrease film development; start with 80 percent of the normal time (less for T-Max films).

A flat or low-contrast negative has highlights that are not very much more dense than the shadows. To get a normal-looking print from a low-contrast negative, print it on a high-contrast (#3 or higher) paper or use a high-contrast printing filter (start with #3, for example).

Low contrast can be the result of low contrast in the original scene or from underdeveloping the negative. If your negatives are often flat, increase film development; try developing 20 percent more than the normal time (less for T-Max films).



Photographic Chemistry
The Developer

- The purpose of development is to convert the latent image formed at the time of exposure to a lasting visible image on the film that can be viewed, or printed.
- Develop means to make visible.

Review: Light Sensitive Crystals

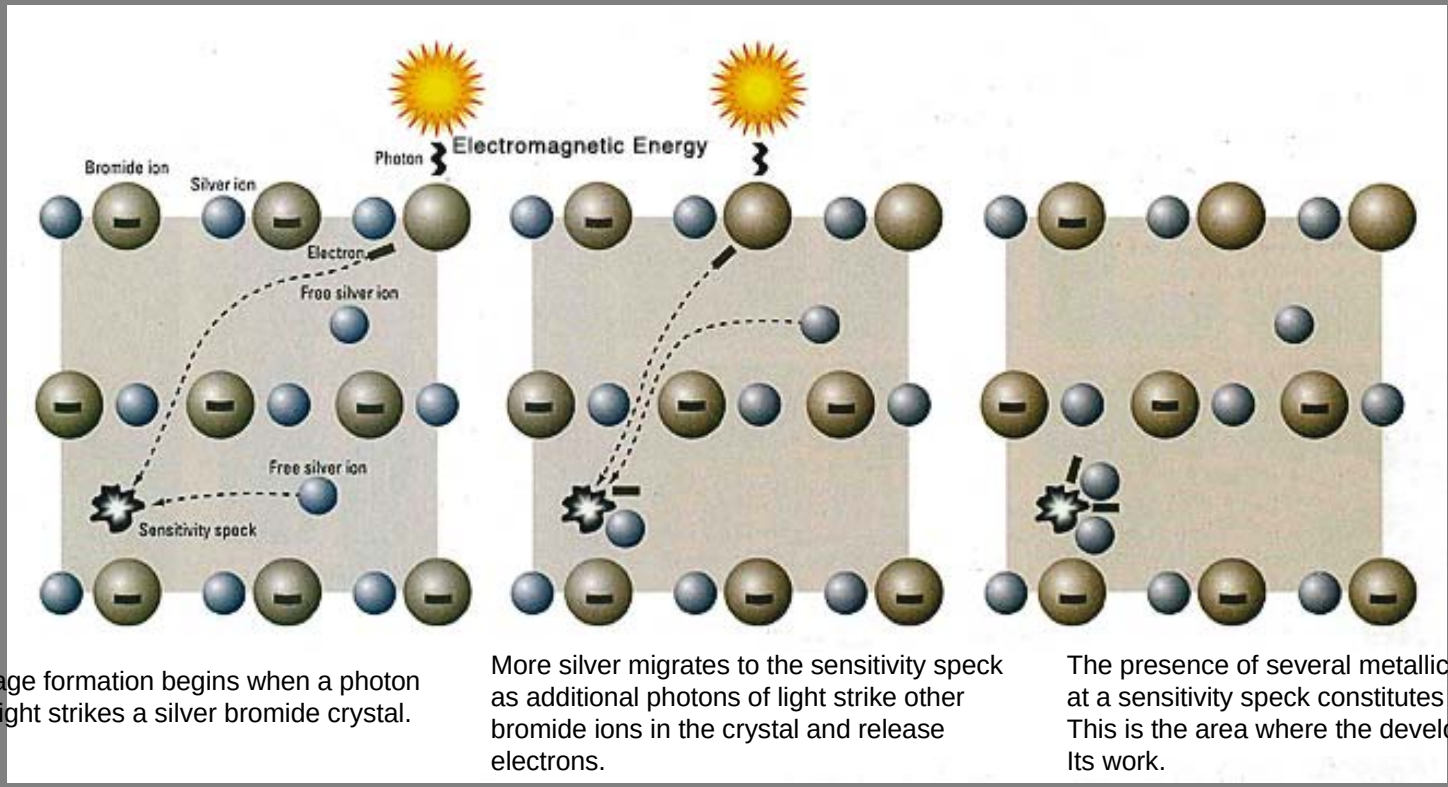


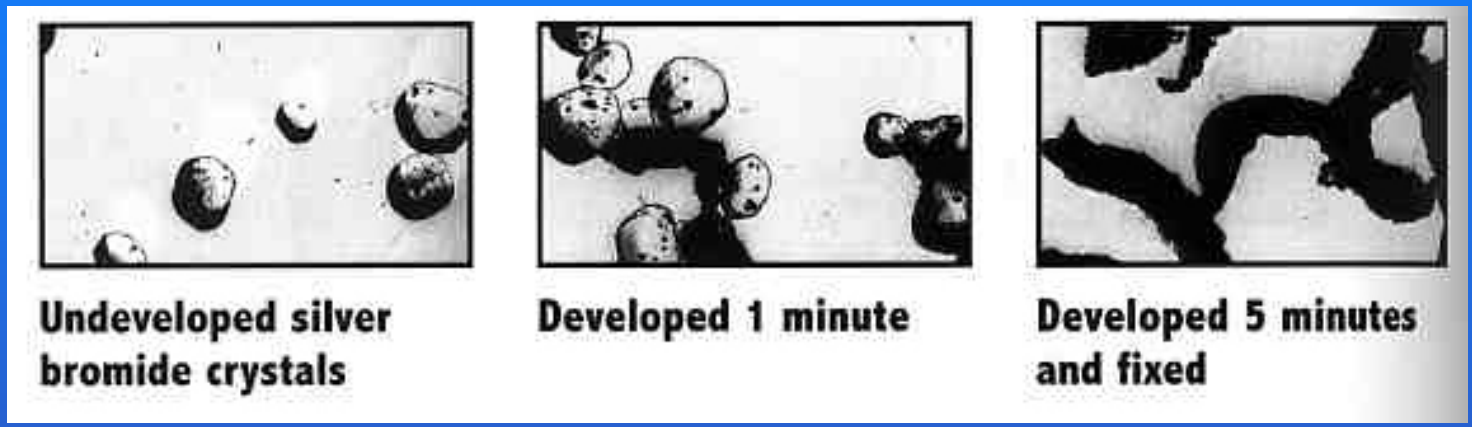
Image formation begins when a photon of light strikes a silver bromide crystal.

More silver migrates to the sensitivity speck as additional photons of light strike other bromide ions in the crystal and release electrons.

The presence of several metallic silver atoms at a sensitivity speck constitutes a latent image. This is the area where the developer will do Its work.

- Review: Each crystal contains silver atoms combined with a halogen such as bromine, chlorine, or iodine in light sensitive compounds like silver bromide.
- These crystals are referred to as: **silver halide crystals.**
- ***The developer converts the silver halide crystals into metallic silver.***

The reducing or developing agent



An important ingredient in the developer is the ***reducing agent***, also called the ***developing agent***.

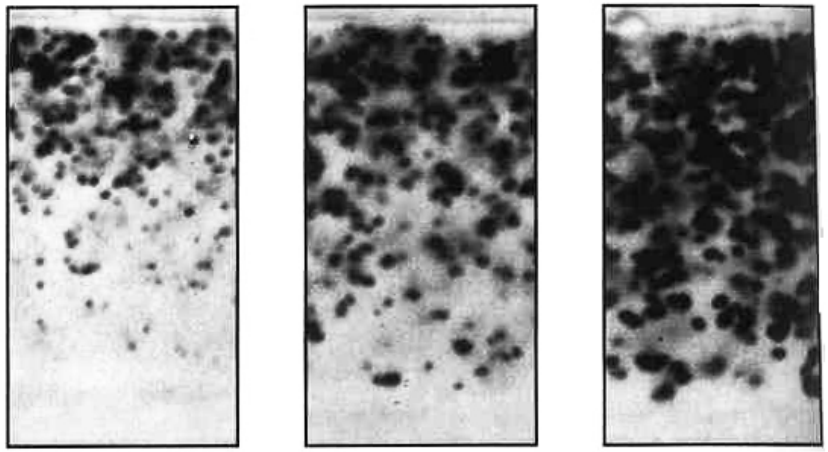
Its job is to free metallic silver from the emulsion's crystals so it can form the image.

The ***reducer*** cracks the exposed crystals into their components: metallic silver, which stays to form the dark parts of the image, and the halogen, which unites chemically with the developer.

The developer consists of 4 components

1. ***Developing Agent.*** This ingredient converts the silver halides to metallic silver.
2. ***Activator.*** Borax or sodium carbonate is added to provide a basic PH solution that gives the developing agent a proper working alkaline environment.
3. ***Restrainer.*** Potassium bromide is added to prevent the developing agent from working on unexposed silver halide crystals thus preventing fogging of the negative.
4. ***Preservative.*** Sodium sulfite is an anti-oxidant that slows down the oxidation of the developer. In addition, it also slows down evaporation.

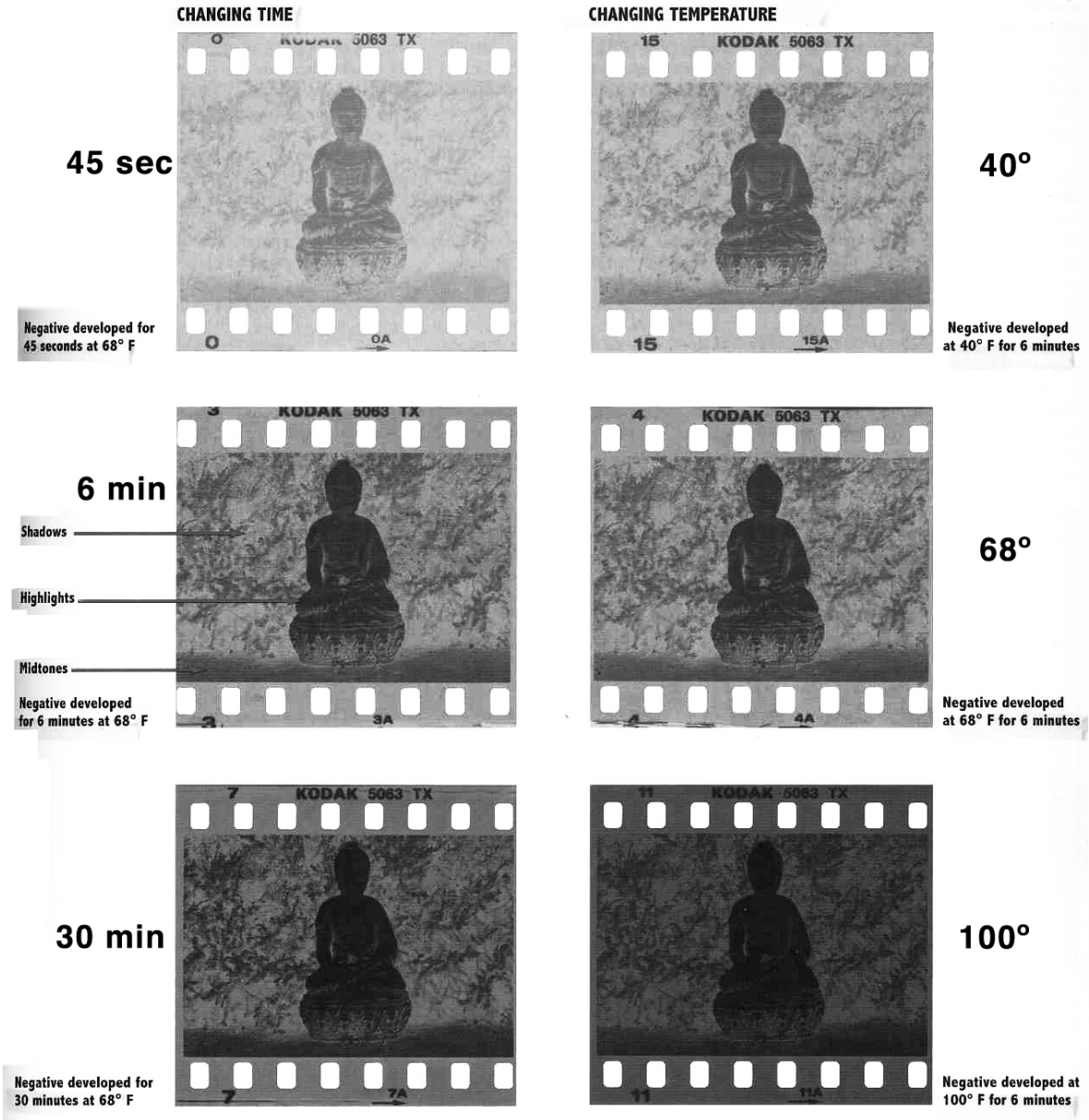
How time affects Development



Developed for 2 minutes | Developed for 5 minutes | Developed for 15 minutes

- Grains of silver in the emulsion get denser as development time increases. As the developer soaks down into the emulsion, subsurface grains form. Your original exposure will determine how many crystals are available to the developer, the amount of processing time will determine how deep the developer will penetrate.
- Development time will control how contrasty and dense the negative will become.

The Developer's temperature also affects development



- The higher the temperature the denser the negative will become.

All processing solutions should be kept to within + or -3º to prevent reticulation of the emulsion.

Reticulation, a crinkling of the emulsion is caused by sudden, and extreme temperature changes during processing.

The temperature generally recommended is *68º F*, which combines efficient chemical activity with the least softening of the emulsion.

Below 65º the reducing agent, hydroquinone becomes ineffective in its ability to reduce silver halide crystals.

Time and Temperature Charts

Kodak T-Max 400 Professional Film

Developing Times (Minutes)—Roll Film

Small Tank

(Agitation at 30-Second Intervals)

EI (Film Speed)	Kodak Developer	65° F (18° C)	68° F (20° C)	70° F (21° C)	72° F (22° C)	75° F (24° C)
400	T-Max (1:4)	NR	7	6 1/2	6 1/2	**6**
400	D-76	9	**8**	7	6 1/2	5 1/2
400	D-76 (1:1)	14 1/2	**12 1/2**	11	10	9
400	T-Max RS	NR	7	6	6	**5**
320	HC-110 (Dil B)	6 1/2	**6**	5 1/2	5	4 1/2
200	Microdol-X	12	**10 1/2**	9	8 1/2	7 1/2
320	Microdol-X (1:3)	NR	NR	20	18 1/2	**16**

Note: The primary development times are in bold face.
NR—Not recommended

- After mixing our developer, use a thermometer to measure the temperature of the developer.
- Find the film/developer combination you are using. Move across the chart until you are under your developer's temperature, the resulting number will be the time you will use to develop your film.

Developer Exhaustion

- Exhausted developer produces underdeveloped negatives because the developing agent is exhausted.
- To prevent this, and to provide more consistent results, we will use the developer as **ONE SHOT**, meaning it is used once, and discarded down the drain.

Agitation

- Agitating film too often and too vigorously will force the developer through the sprocket holes that will cause overdevelopment edges.
- We will agitate our film for the first 30 seconds at the beginning of the developing time, then 5 seconds every 30 seconds thereafter.

Photographic Chemistry

Other chemical solutions used to process Black and White film

Stop, Fixer, Hypo Clear, Wetting Agent

>Chemicals are sold as ***stock solutions***. When it is to be used, it is diluted into a ***working solution***.

>Dilutions: given as a ratio. For example 1:3 requires 1 part chemical to 3 parts water.

- **Stop bath.** This is a mild acid bath that stops the action of the developer.
- This chemical is reused, pour back into bottle.

Photographic Chemistry

Other Chemical Solutions to Process Black & White Film

Stop bath, Fixer, Washing aid, Wetting Agent

- **Fixer (also called hypo).** Converts the remaining silver halide crystals that are still light sensitive into a soluble form, so they can be washed out of the emulsion, making the image no longer sensitive to light, and permanent.

✓ The silver halide solvent in ordinary fixers is usually sodium thiosulfate.

✓ Ammonium Thiosulfate is a faster-acting silver halide solvent used in rapid fixers.

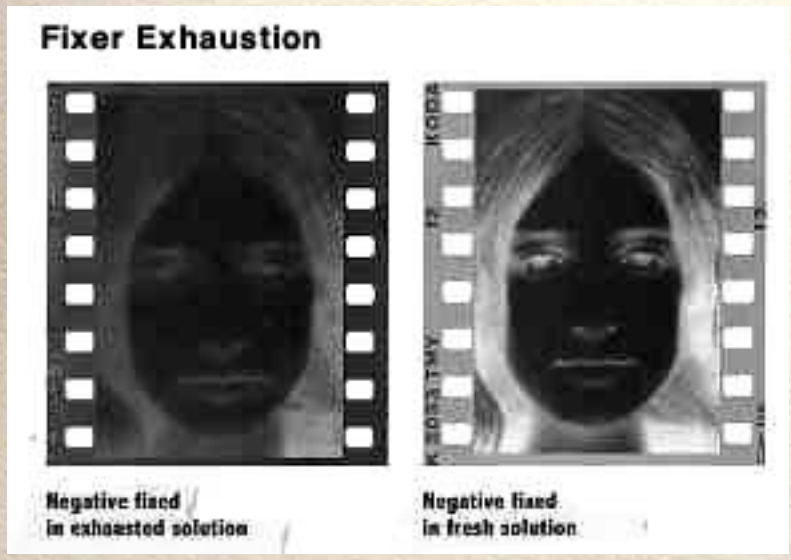
> *The early name for fixer was sodium hyposulfite, and it is still often called hypo.*

- Most fixers have other components. A highly diluted acid-usually acetic acid-may be included to insure that the developer is neutralized. An agent such as potassium alum is often added, which hardens the emulsion and makes it less susceptible to scratches and damage.
- This chemical is reused, pour back into bottle. When exhausted it is poured into the reclamation bottle.

Photographic Chemistry

Other Chemical Solutions to Process Black & White Film

Stop bath, Fixer, Washing aid, Wetting Agent



Use **Hypo Check** to test fixer strength. Add a few drops to the fixer. If the drops dissolve and remain clear the fixer is good. If the drops becomes cloudy, the fixer is exhausted - do not use. Pour exhausted fixer into the reclamation bottle.

Incompletely fixed negatives have a milky or cloudy appearance. If this condition is noticed, the film can be saved by refixing in fresh fixer.

Photographic Chemistry

Other Chemical Solutions to Process Black & White Film

Stop bath, Fixer, Washing aid, Wetting Agent

- **Washing Aid** (also called a hypo clearing bath). After the film has been fixed and rinsed, immersing it in the washing aid solution, provides for a shorter wash time, saving water, and reducing swelling and softening of the emulsion.
- The wash aid converts the residual thiosulfate to sodium sulfite which is soluble in water.

✓ This chemical is reused, pour back into bottle.

✓ When the chemical turns purple, it is exhausted, discard down the drain.

- **Wetting Agent.** Reduces the surface tendency of water to cling onto the film preventing water spots during drying.

Chemical Safety

- Photographic chemicals should be handled with reasonable care, like all chemicals.
- Material Data Safety Sheets (MSDS) provide information about the chemical products used.
- If you are sensitive to chemicals use print tongs.
- Avoid getting chemicals in your eyes, and mouth.
- Clean up spills.
- Dispose of chemicals properly.

What you will need to process your film

HOW TO PROCESS BLACK-AND-WHITE ROLL FILM

Equipment and Supplies You'll Need

EQUIPMENT TO LOAD FILM

Developing reel holds and separates the film so that chemicals can reach all parts of the emulsion. Choose a reel to match the size of your film, for example, 35mm, or the larger 120 roll-film size. Some plastic reels adjust to different sizes.

Stainless-steel reels are a bit more difficult to learn to load than plastic reels. However, many photographers use them because they are durable and easy to clean of residual chemicals.

Developing tanks accept one or more reels loaded with film. Loading must be done in the dark, but once the film is inside and the light-tight top in place, processing can proceed in room light. A light-tight opening in the top of the tank lets you pour chemicals in and out. Ideally, the cover should let you turn the tank upside down to agitate the solution inside during processing.

Miscellaneous: **Bottle-cap opener** pries off the top of a 35mm film cassette. Special cassette openers are available. **Scissors** trim the front end of 35mm film so it is square and cut off the spool on which the film was wound. **Practice roll of film** lets you get used to loading the developing reel in room light before trying to load an actual roll of film in the dark. Light hitting the practice roll will ruin it, so don't use a roll you want to keep.

A completely dark room is essential for loading film on the reel. Even a small amount of light can fog film. The room is not dark enough if you can see objects in it after 5 minutes with lights out. If you can't find a dark enough room, use a **changing bag,** a light-tight bag into which fit your hands, the film, reel, tank, cover, opener, and scissors. After the film is loaded on the reel and in the tank with the cover on, you can take the tank out of the bag into room light.

...TO PROCESS FILM

TRI-X FILM	65° F	68°
D-76	9 min	8 min
HC-110 (Dilution B)	8 1/2 min	7 1/2 min
Microdol-X	11 min	10 min
Xtol	7 min	6 min

Manufacturer's instructions, which are included with the film or developer, give recommended combinations of development time and developer temperature.

Containers for working solutions must be large enough to contain the quantity of solution needed during processing. Measuring graduates are convenient to use. Have three for the main solutions—developer, stop bath, and fixer. It is good practice to reserve a container for developers only; even a small residue of stop bath or fixer can keep the developer from working properly.

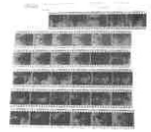
Optional: **Tray or pan** can be used as a water bath for the containers of working solutions to keep them at the correct temperature.

Timer with a bell or buzzer to signal the end of a given period is preferable to a watch or clock that you must remember to consult. An interval timer can be set from 1 sec to 60 min and counts down to zero, showing you the time remaining.

Film washer is the most efficient way to wash the film. If one isn't available, you can insert a hose from a water tap into the core of the reel in the processing tank.

Film clips attach washed film to a length of string or wire to hang to dry. Spring-loaded clothespins will do the job. A dust-free place to hang the wet film is essential. A school darkroom usually has a special drying cabinet; at home, a bathroom shower is good.

Optional: **Photo sponge** or squeegee to wipe down wet negatives so that they dry rapidly and evenly.



Negative storage pages protect the dry film.

...TO MIX AND STORE CHEMICALS

Source of water for mixing solutions, washing film, and cleaning up. A hose on a faucet splashes less than water straight from the faucet.

Photographic thermometer measures the temperature of solutions. An accurate and easy-to-read thermometer is essential because temperatures must be checked often and adjusted carefully. You will need a temperature range from about 50° to 120° F.

Graduated containers measure liquid solutions. Two useful sizes are 32 oz and 8 oz. Graduates can also be used for mixing and for holding the working solutions you will need during processing.

Mixing containers hold solutions while you mix them. You can use a graduated container for small quantities or a container with a wide mouth for larger ones.

Storage containers hold chemical solutions betwen processing sessions. They should be of dark glass or plastic to keep out light. Caps should close tightly to minimize contact with air, which causes oxidation and deterioration of chemicals. Some plastic bottles can be squeezed and capped when partially full to expel excess air.

Stirring rod mixes chemicals into solution. The rod should be of an inert and nonabsorbent material such as hard plastic that will not react with or retain chemicals.

Funnel simplifies pouring chemicals into storage bottles.

Safety equipment, such as rubber gloves, tongs, and safety goggles, protects you from unwanted exposure to chemicals. See details on page 112.

Steps to process film