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Good Lighting for Advanced 4-H Electrification Club Members and Leaders: Extension Circular 7-71-2

M. L. Mumgaard

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good lighting

For Advanced 4-H Electrification
Club Members and Leaders

EXTENSION SERVICE
UNIVERSITY OF NEBRASKA COLLEGE OF AGRICULTURE
AND U.S. DEPARTMENT OF AGRICULTURE
COOPERATING
W. V. LAMBERT, DIRECTOR
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Good Lighting
By M. L. Mumgaard and Don K. Wiles

You are about to participate in a 4-H project for members who have taken first-year electrification. During the year you will be expected to do the following:

1. Become acquainted with the principles of good lighting, and how to apply them.
2. Become acquainted with the various methods of lighting.
3. Select some room in your home or farm buildings that needs some improvement for good lighting and make at least one needed improvement.
4. Make or remodel a light unit for indoor or outdoor use. This unit may be a portable light, a study center, a light fixture, or some other similar article. It may be something that will satisfy the previous requirement.

The purpose of this manual is to help you with your project by providing basic information about good lighting. It will not necessarily answer all your questions about lighting. For further information talk with your electrical dealer, power supplier, and county agent. They will have material and bulletins to use with the information in this manual.

This manual is also prepared to help you with your club meetings. Each problem is designed to be used as a topic for discussion. At the end of the problem are some suggestions of "Things To Do." If properly prepared for and used, the suggestions will do much to encourage discussion of the topic. Good meetings require preparation -- so be sure to prepare for the club meeting well in advance.

Problem One
PRINCIPLES OF GOOD LIGHTING

You Need Your Eyes and Your Eyes Need You

You rely upon sight more than upon any of the other senses. It has been estimated that 87% of the outside impressions are received by the sense of sight, 7% by hearing, 3 1/2% by smell, 1 1/2% by touch, and 1% by taste. A very high percentage of the people of the United States are able to read and are required to read and study to do their daily work.

You are about to participate in a 4-H project for members who have taken first-year electrification. During the year you will be expected to do the following:

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Problem One
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Your eyes are marvelous and delicate organs that convert light into sight. To further understand how your eyes work, consider the working parts of a camera. A camera is constructed on practically the same principle that nature used in creating eyes. Both the eye and the camera have a lens through which the light enters. Both the eye and the camera record pictures; the eye records the picture within the human mind while the camera records the picture on film. Both the eye and the camera require proper lighting to obtain clear pictures.
The main difference between your eyes and a camera is that if the light is poor the camera does not care, but your eyes do. The camera simply registers a poor picture, while your eyes try to adjust to the situation. If the eyes are continually exposed to poor lighting, the muscles of the eyes become exhausted. This may result in ailments such as headaches. The continued use of poor light often causes permanent injury to the eyes.

Rules for Proper Lighting

If you desire to take good pictures, either with the eye or with a camera, there are four rules to follow:

RULE ONE: Have enough light. You cannot expect to record a picture unless there is light — without light there is no sight. Pictures recorded by a camera in poor light do not reproduce clearly. The same is true with your eyes, but your mind eventually accepts the poor reproduction and allows your eyes to suffer.

Since your eyes and brain are not always good judges of light, man has developed a means of measuring light with light meters. The unit of measurement is called foot-candle. A foot-candle is the amount of light given by a standard candle on a square foot of white paper at a distance of 1 foot. See figure 2.

The amount of light that is needed varies, depending upon the amount of detail that needs to be recorded in the picture. For example: you do not need as much light to see when you are walking as you do when you are reading. Listed below is the recommended amount of light for various phases and activities.

- 5 foot-candles—General lighting in hall, stairs.
- 10 foot-candles—General kitchen light, over card tables.
- 20 foot-candles—Casual reading (large type), writing, average sewing for a small amount of time, dressing table mirror (both sides of face).
- 40 foot-candles—Reading for prolonged periods of time, reading small type, prolonged sewing, children's study table, work counter, range, sink, workbench, bathroom mirror (both sides of face), ironing.
- 100 foot-candles—Sewing on dark goods, fine needlework.

In any one location you may need a small amount of light at one time, a large amount at another time. The important thing is to see that enough light is available at each place for the most exacting work to be done.

RULE TWO: Avoid glare. Concentrated light, such as caused by glare, may destroy the picture. In the case of a camera, the picture is overexposed and the developed film is white.

Glare from a very bright bulb or tube can be almost blinding. Even a small part of a bulb or tube showing below a lamp shade hurts the eyes. Bulbs close to the ceiling are less annoying than those lower down where you must look at them often.

Glare may be caused by a light reflected from a shiny surface. Bright metal, glass, polished furniture, gloss paper, and shiny paint all give back sharp reflections. The reflection of an unshaded bulb on a shiny surface is particularly troublesome.
To demonstrate glare try the following: Place a two-inch hole in the middle of a piece of cardboard. Around the hole write the words "Can you read this?" Set the cardboard on a table. Hold an unlighted 150-watt bulb against the hole from the back. Notice that you can read the lettering around the hole. Then turn on the light. You will no longer be able to read the lettering because of glare. See figure 3.

RULE THREE: Avoid sharp contrasts of light and dark. Sharp contrasts of light and dark are tiring because the eyes must adjust constantly from light to dark. Pictures taken by your camera and developed on the wrong type of paper give sharp contrasts between black and white. As a result, such pictures are not pleasing to look at. The same is true with pictures that are recorded through your eyes.

A single bright lamp in a room forms a glaring pool of light, especially if the lamp has a solid shade or shield that lets no light through to brighten the surrounding area. Though the amount of light needed for sewing, reading or shop repair can best be supplied by a well-placed lamp or fixture, there should always be some light in the rest of the room.

RULE FOUR: Put shadows in their place. Have you ever taken a picture of someone, only to have the picture come back with a misplaced shadow? The same thing happens when you are working, and some part of your body comes between the light and your work. Improperly placed shadows reduce the amount of light falling on your work, and create a sharp contrast between light and dark.

Good lighting does not eliminate shadows. It simply keeps them off of what you are trying to see. Shadows can be placed in harmless locations by having your lamps and light fixtures in the right relationship to your work.

To better understand the importance of properly located shadows, try writing with a lamp located on one side of you and then the other side. You will soon notice that it is more difficult to work with the shadow on your work. Over a long period of time the shadow will become tiring to your eyes. When working, writing or sewing, be sure that the light comes from the side opposite the hand being used. See Figure 5.
THINGS TO DO

(1) Bring a camera to the club meeting and discuss the working principle of the camera and the eye.
(2) Obtain a light meter -- one can usually be borrowed from your electrical dealer, power supplier, or county superintendent -- and become familiar with the amount of light needed for various activities. This may be done at a club meeting.
(3) Bring pictures that have been taken with a camera to the club meeting--preferably pictures that have some faults -- and note which of the four rules for taking good pictures were violated.
(4) Try the suggested demonstrations for lighting rules two, three and four; and become familiar with the principles of good lighting.
(5) Those present at a club meeting might judge several rooms for proper lighting. Reasons may be given as to why one is better lighted than another.
(6) Each member should select a room in his house or farm building which does not meet the requirements of good lighting and determine what rules are violated.

NOTE: The room selected will be the room which you will carry through as your project room. During the club year you will learn various simple and inexpensive ways to improve the lighting in your selected room, and you will be required to make at least one improvement. You should be sure that you have full support of your parents before selecting the room -- better yet, you might have them help you with the selection. (If you desire, you may improve the lighting in more than one room.)

Problem Two

SOURCES OF LIGHT

Either of two sources of light may be used in lighting houses and farm buildings. The sources are incandescent bulbs and fluorescent tubes. Fixtures using incandescent bulbs are more varied in shape than those using fluorescent tubes. Light from a fluorescent fixture is especially good where you need a long line of light or a large amount of light over a rather large working area.

Incandescent and fluorescent light can be used in the same room.

The Incandescent Light Bulb: Its Operation and Parts

Let's look at an ordinary 60-watt lamp and consider how it works. When you place the bulb in the lamp socket and "turn on" the switch, you cause an electric current to flow through the filament. The energy used to move electricity through the filament heats the filament, and light and heat are given off. The filament appears to be only an inch or so in length but actually contains over two feet of coiled tungsten wire. Figure 6 shows how the lamp filament is constructed.

Parts Of Incandescent Bulb

For a more complete picture of the parts of an incandescent bulb, see figure 7.
THE BULB is made of special glass.
THE ATMOSPHERE in the bulb is composed of argon and nitrogen gas.
THE FILAMENT of tungsten wire is coiled and recoiled.
SUPPORT WIRES hold filament and lead-in wires in the proper position.
A GLASS BUTTON holds the support wires.
LEAD-IN WIRES are made of copper, steel, and nickel.
THE CENTER STRUCTURE is made of glass.
CEMENT of a bakelite composition is used to join the base and bulb.
THE BASE is made of brass or aluminum with a glass insulation ring and a contact disk at the bottom.

The bases of most bulbs in common use have a standard-sized medium screw; thus, bulbs of different wattage can be used in the same socket. Three-light bulbs of the 100-200-300 watt size, some of those of the 50-100-150 watt size, and regular bulbs of more than 300 watts have a large base known as a "Mogul" base. Christmas tree and other special bulbs have a small base.

Types Of Incandescent Bulbs

Bulbs in most general use are inside-frosted. A newer type has an inside coating that makes the glass look milk white and gives a softer light. Clear glass bulbs are not desirable. They give a glaring light and should be used only when enclosed in a diffusing light fixture or in a shielded reflector.
"Daylight blue" bulbs are similar in shape to the standard bulb and are useful where a bluish-white light is especially desirable -- for instance, in the laundry to show up scorch or stains. Light from pink bulbs is flattering to one's complexion and may be used for general lighting purposes. Since color cuts down the amount of light, higher wattage bulbs are needed.

Bulbs of other colors are suitable only for decorative purposes.

Silvered-bowl bulbs reflect their light toward the screw base of the bulb. This bulb is used in closets and similar places where indirect lighting is desired. Another type of bulb which applies the same principle is the decorator bulb. It is different in shape from the standard and silvered-bowl bulbs. It has an ivory color and gives a softer light downward. It is used in unshaded fixtures where more light and less glare is desired.

A reflector spot or flood lamp has a built-in reflector to deliver light in a definite direction. It is larger in diameter than most bulbs used in the home or on the farm and is flattened at the bowl end. For outdoor use there are bulbs of similar shape made of hard glass and called projector bulbs.

A bulb known as a white indirect light is shaped like the reflector bulb and has a milk-white inside coating. Because the coating on the sides is heavier than on the flattened end, the bulb can be used without a diffusing bowl.

A three-light bulb has two filaments which can be used separately or together to give three different amounts of light. This bulb requires a special three-light socket.

Higher wattage bulbs supply light more economically than those of low wattage; a 100-watt bulb gives about the same light as two 60's or six 25's and costs less to purchase and to operate. There are some places where it may be better to use several smaller bulbs in order to have a better spread of light.

The Fluorescent Tube: Its Operation And Parts

Fluorescent light is easily recognized by the tubes that produce it. When the switch controlling the electricity is "turned-on," a flow of electricity is started through the tube. The electrical current enters and leaves the tube by way of filaments similar to those in an incandescent bulb. These filaments are located at each end of the tube. Argon gas and vaporized mercury within the tube provide a path for the flow of electricity between the filaments. This flow of electrical current produces ultra-violet rays which are invisible to human eyes. The rays fall on the inner coating of the tube and cause it to give off light.

Figure 9. Parts Of Fluorescent Tubes
Several kinds of bases are used. The most common are the disc base, the medium bipin, and the single pin base. Examples of the three types of bases may be seen in figure 10.

Types of Fluorescent Tubes

Because of the different inner coatings, the light from fluorescent tubes varies. The first fluorescent tubes gave off a bluish light in contrast to the familiar yellowish white of incandescent light. Since then, other colors have been developed that are more like the filament light and more flattering to complexions and home furnishings. Those best suited to home use are as follows:

<table>
<thead>
<tr>
<th>Name of Tube</th>
<th>Color Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard cool white or 4500° white</td>
<td>Bluish-white light. Often preferred in the laundry to show up spots and scorch.</td>
</tr>
<tr>
<td>White</td>
<td>A good general-purpose white light for kitchens, workrooms, basements.</td>
</tr>
<tr>
<td>Standard warm white</td>
<td>The most efficient fluorescent light. It emphasizes green, yellow, and orange colors. Use where amount of light is more important than appearance of complexions.</td>
</tr>
<tr>
<td>Deluxe cool white, deluxe warm white, soft white</td>
<td>Less light per watt than the others, but their light is kinder to complexions and more pleasing with most room color schemes. The deluxe cool white should be used in all cases except where special effects such as room, drapes, or furniture colors are to be emphasized. In such cases, deluxe warm lights are usually preferred.</td>
</tr>
</tbody>
</table>

Tubes in common use are 15 to 48 inches long; the wattage varies with the length. There are some longer tubes--a few as long as 96 inches--and there are circular tubes, which are called "circline." Because tubes of different wattages are also of different lengths they are not interchangeable as are most incandescent bulbs. It is most important to choose a fluorescent fixture that uses tubes of the size that gives the right amount of light. Most fluorescent fixtures are a little more expensive than good incandescent ones and the tubes cost more than bulbs, but fluorescent tubes produce at least three times as much light per watt as incandescent bulbs and last several times as long.

If you are going to replace incandescent bulbs with fluorescent tubes you need to know what size to use. There is no exact rule to follow, but in general you can replace a 60-watt incandescent bulb with a 15-20 watt fluorescent, and a 100-150-watt incandescent bulb with a 40-watt fluorescent tube.

Fluorescent light fixtures will be heavier than those required for incandescent lights. Thus, the problem of supports should be considered. Types of fixtures are discussed in later problems.
Other Things You Should Know About Fluorescent Tubes

Here are some things to remember when using fluorescent tubes for lighting:

1. Fluorescent tubes do not operate satisfactorily at voltages below 100.

2. Fluorescent tubes require additional devices, such as ballasts and starter switches, to make them operate properly. See figure 11.

The ballast provides a high voltage to start and maintain the flow of electricity through the tube. It also limits the amount of current flowing through the tube and thus prevents damage to the tube and wiring circuit. If a humming sound develops in a fluorescent fixture, the ballast may need to be remounted or perhaps replaced.

Before electricity can flow through a tube, the two filaments must be hot. They are heated by completing an electrical circuit from one filament to the other by a special wire in the light fixture. Once the two filaments are hot the circuit is broken, and the electricity flows through the tube. This is the job of the starter switch. (See figure 11.) The starter switch is automatic and used on ceiling and larger fixtures. Special instant starting tubes and fixtures can be had at somewhat greater cost. Starters are not required for these. "Slim-line" tubes are of the instant starting type. On many desk lamps starter switches are not used because the filament heating circuit is completed by holding down a switch until each end of the tube glows. When the filaments are hot and glowing, you release the switch and the electric current arcs across the tube.

3. Fluorescent lights will not work satisfactorily outdoors where the temperature is below 50°F. In places well protected from drafts, fluorescent lights may perform satisfactorily in temperatures as low as 32°F. Special fixtures and tubes may be obtained for low temperatures.

4. Never use one tube alone. This is because the electrical current in Nebraska is an alternating current. It flows in one direction, stops, flows in the other direction, stops, and flows back again. This cycle of alternating current occurs 60 times a second. Each time a change is made the fluorescent light goes out. Over a period of time your eyes become aware of this blinking if one tube is used. By using two tubes, the circuits are so arranged that one tube is on when the other is off.

5. When a tube noticeably blinks on and off it is time to replace it with a new one. Flickering of the tube will damage the starter and the ballast.

6. To reduce the possibility of radio interference, many new fluorescent fixtures have condensers built into the starters. Before buying a plug-in fluorescent lamp, ask to try it out in your home to find out whether it interferes with your radio. If you are already having trouble, locate the radio or lead-in wire and the fluorescent unit at least 10 feet apart. A radio interference filter installed on the fixture or on the radio will further reduce the difficulty.

7. Fluorescent tubes should be shielded to prevent glare.
THINGS TO DO

(1) Become acquainted with the different sources of light -- bulbs and tubes. Bring different types of bulbs and tubes to the club meeting and have an identification contest.

(2) Determine the cost of using 100 or 150-watt bulbs as compared with the cost of using 40 or 60-watt bulbs to obtain equal lighting in a room. Use the power rate for your area.

(3) Determine if the correct source of light is being used in the room which you selected to improve.

Caution -- Do Not Break Bulbs or Tubes

This caution should be applied to both incandescent bulbs and fluorescent tubes. There is added danger with fluorescent tubes because of the phosphorous coating in the tube. In either case you might be cut with flying glass particles. If it is necessary to break bulbs or tubes, do so after placing them in a sack or some other enclosed container.

Problem Three

GENERAL LIGHTING

In most cases two types of lighting are needed. They are general lighting and specific lighting. General lighting is usually provided by overhead fixtures and/or a series of lights along the walls of the room. Good general lighting aids in softening shadows and in eliminating the contrasts between light and dark.

Specific lighting is usually provided by spotlights and/or portable lights. Specific lighting gives us the light we need for specific tasks. The use of specific lights will be discussed in later problems.

Methods Of Lighting

There are four methods of lighting: direct, indirect, semi-direct, and semi-indirect.

Direct Lighting is the method by which the light is thrown directly into the room. A good example is a reflector, as shown in figure 12. It has the disadvantage of producing sharp shadows and glare.

Semi-Direct Lighting finds most of the light being directed downward and outward. Some of the light strikes the ceiling and is then reflected downward. Its best example is the enclosed glass kitchen fixture, as shown in figure 13. Direct rays of the bulb are broken up by the frosted glass bowl. This method reduces the glare and makes the surroundings more cheerful.
Semi-Indirect Lighting, as illustrated in figure 14, directs most of the light upward to the ceiling, where it is reflected downward. The rest of the light is directed downward. A translucent bowl suspended from the ceiling with a light bulb in the center is a good example.

Figure 14.
Semi-Indirect Lighting

Indirect Lighting directs all the light upward to the ceiling to be reflected downward in the room, as illustrated in figure 15. A good example is an opaque bowl placed under a bulb and suspended from the ceiling. This method softens the shadows by distributing the light better. Direct glare from the bulb is eliminated.

The most desirable general lighting is indirect lighting which eliminates both harsh glare and shadows. Indirect general lighting cannot always be obtained because of mechanical or economic conditions, but in all cases you should try to obtain as nearly as possible the effects of indirect lighting.

Color Of Surroundings: Its Effect Upon General Lighting

Color is an important factor in lighting. Dark areas, such as walls, ceilings, and furnishings, absorb more light than light colored areas. This absorption reduces the light available for vision. Light surfaces reflect a greater proportion of the light they receive. The following shows the amount of light reflected by different colors:

<table>
<thead>
<tr>
<th>Color</th>
<th>Reflection Factor</th>
<th>Color</th>
<th>Reflection Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>82%</td>
<td>Dark gray</td>
<td>30%</td>
</tr>
<tr>
<td>Cream</td>
<td>75%</td>
<td>Dark red</td>
<td>13%</td>
</tr>
<tr>
<td>Light gray</td>
<td>75%</td>
<td>Dark brown</td>
<td>10%</td>
</tr>
<tr>
<td>Light yellow</td>
<td>75%</td>
<td>Dark blue</td>
<td>8%</td>
</tr>
<tr>
<td>Light green</td>
<td>65%</td>
<td>Dark green</td>
<td>7%</td>
</tr>
<tr>
<td>Light blue</td>
<td>55%</td>
<td>Maple</td>
<td>42%</td>
</tr>
<tr>
<td>Medium yellow</td>
<td>65%</td>
<td>Satinwood</td>
<td>34%</td>
</tr>
<tr>
<td>Medium gray</td>
<td>55%</td>
<td>English oak</td>
<td>17%</td>
</tr>
<tr>
<td>Medium green</td>
<td>52%</td>
<td>Walnut</td>
<td>16%</td>
</tr>
<tr>
<td>Medium blue</td>
<td>35%</td>
<td>Mahogany (dark)</td>
<td>12%</td>
</tr>
</tbody>
</table>

Inexpensive Ways to Improve General Lighting

You may find that your present general lighting has one or both of the following faults: (1) bare light bulbs or tubes and (2) not enough light. The bare light bulbs violate our second rule, "Avoid glare"; the second fault would violate rule number one, "Have plenty of light."
Make your light as indirect and as adequate as possible. In so doing, you may be able to use larger bulbs and comply with rule number one as well as rule number two. For fixtures that have two or more bulbs hanging downward with no shields, the least expensive way to correct the situation is to use "decorator" bulbs. This bulb sends light both upward and downward and the bright filament image is eliminated. This bulb is available in two sizes: 50-watt and 100-watt. "Silvered-bowl" bulbs are useful in low bulb fixtures used in utility areas, basements and garages. Both the "decorator" and "silvered-bowl" bulbs must be used with base upward. See figure 8 for pictures of bulbs.

General lighting can also be improved by using adapters that hold a shield under the bulbs. These shields direct some of the light upward and diffuse the downward light.

The simplest adapter is the "clip-on". See figure 16. These adapters are most effective if used in sockets close to the ceiling. "Clip-on" shields or louvers are also available for fluorescent tubes.

For heavier shields and louvers, the clip-ons are not satisfactory. A number of adapters are available which meet this problem, as shown in figure 17. When using these adapters, be sure to follow instructions about the size of bulbs that can be used. If the bulbs are too large, the excessive heat will discolor or may even melt or burn the adapter shield.

Permanent Fixtures For General Lighting

Many types of fixtures may be used. However, some light fixtures are more satisfactory in a specific place than others. Some of the more common general light fixtures are:

**CEILING AND WALL FIXTURES**

<table>
<thead>
<tr>
<th>Type</th>
<th>Length or diameter (Inches)</th>
<th>Recommended bulb or tube (Watts)</th>
<th>Suitable location</th>
<th>Description and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent, dome reflector, direct</td>
<td>12</td>
<td>Silvered bowl, 150</td>
<td>Garage, basement, attic, workbench.</td>
<td>A utility fixture. Place directly over work center. To reduce harsh shadows, use more than one fixture.</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Daylight, 150</td>
<td>Over laundry tubs.</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Length or diameter (Inches)</td>
<td>Recommended bulb or tube (Watts)</td>
<td>Suitable location</td>
<td>Description and use</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>----------------------------------</td>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fluorescent, reflector, direct</td>
<td>24</td>
<td>Two 20's</td>
<td>Over laundry tubs, ironer, workbench</td>
<td>Gives even light over long area. Use size needed. Attach to ceiling or hang lower for more light.</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>Two 25's</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>Two 30's</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>Two 40's</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorescent, shielded, semi-direct</td>
<td>24</td>
<td>*Two 20's</td>
<td>Very small kitchen</td>
<td>Side shields and cross louvers make light more comfortable. In large kitchens, use more than one fixture.</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>*Two 25's</td>
<td>Small kitchen.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>*Two 40's</td>
<td>Average kitchen.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>*Four 40's</td>
<td>Large kitchen.</td>
<td></td>
</tr>
<tr>
<td>Fluorescent, circular, semi-direct</td>
<td>13</td>
<td>Circline, 32</td>
<td>Small kitchen or utility room, bedroom.</td>
<td>Use where round fixture is more desirable than a long one. Shield softens light.</td>
</tr>
<tr>
<td>Incandescent, enclosing globe, semi-direct</td>
<td>7-9</td>
<td>75</td>
<td>Basement, washroom.</td>
<td>Globe with clear lens in bottom is good for table lighting; globe of opaque glass gives softer light but requires larger bulb.</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>100</td>
<td>Pantry, hall, bath</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>150</td>
<td>Kitchen, laundry.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>200</td>
<td>Large workroom.</td>
<td></td>
</tr>
<tr>
<td>Incandescent, opaque, indirect</td>
<td>12</td>
<td>100</td>
<td>Hall, small bedroom, medium bedroom, large bedroom, living room.</td>
<td>To be used with white or nearly white ceiling. May be designed for silvered-bowl bulb.</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Or equivalent total wattage.
<table>
<thead>
<tr>
<th>Type</th>
<th>Length</th>
<th>Recommended or diameter bulb or tube</th>
<th>Suitable location</th>
<th>Description and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent, shielded, semi-indirect</td>
<td>12</td>
<td>Three 40's</td>
<td>Hall, small bedroom.</td>
<td>May have a single socket but usually has several. May hang quite close to ceiling or lower. With clear glass in bottom gives good down-light for dining table, but do not use for studying.</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Four 40's</td>
<td>Small living room, library, bedroom.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Four or five 60's</td>
<td>Larger living room library, bedroom.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>Five or six 60's</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Four 40's and one 75</td>
<td>Dining room.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorescent, shielded, semi-indirect</td>
<td>18</td>
<td>Two 15's</td>
<td>Hall, bathroom.</td>
<td>Small diameter of tubes permits mounting close to ceiling. Shield lets light through for good down-light.</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>Two 20's</td>
<td>Small bedroom.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>Four 20's</td>
<td>Living room, bedroom, dining room.</td>
<td></td>
</tr>
<tr>
<td>Incandescent with diffusing bowl, semi-indirect</td>
<td>8</td>
<td>100 or (bowl) 50-100-150</td>
<td>Small dining room.</td>
<td>Especially good over dining table that is also used for studying. Hang it 24 to 36 inches above table.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(bowl) 100-200-300</td>
<td>Larger dining room.</td>
<td></td>
</tr>
<tr>
<td>Incandescent, wall bracket, semi-direct</td>
<td>75</td>
<td>or 100</td>
<td>Over bathroom mirror</td>
<td>Shield of glass or plastic is sometimes open at top. Clear lens directs light to face. Bracket includes convenience outlet.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Or equivalent total wattage.
<table>
<thead>
<tr>
<th>Type</th>
<th>Length or diameter (Inches)</th>
<th>Recommended bulb or tube (Watts)</th>
<th>Suitable location</th>
<th>Description and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent, wall bracket, semi-indirect</td>
<td></td>
<td></td>
<td>Both sides of bathroom mirror.</td>
<td>Needs shield of plastic or glass. For good under-chin lighting for shaving mount with bottom of shield about 5 feet, 2 inches above the floor.</td>
</tr>
<tr>
<td>Fluorescent wall bracket, direct</td>
<td>18</td>
<td>15</td>
<td>Both sides and top of bathroom mirror.</td>
<td>Shield is desirable for appearance and eye comfort. Always use deluxe cool white tubes.</td>
</tr>
<tr>
<td></td>
<td>or 24</td>
<td>or 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorescent under-cabinet, semi-direct</td>
<td>18</td>
<td>15</td>
<td>Under kitchen cabinets.</td>
<td>May be plugged into convenience outlet but should be on a switch controlling all cabinet lights. Other types come in 14-, 15-, or 20-watt sizes--some not shielded.</td>
</tr>
<tr>
<td>Incandescent, weatherproof fixture</td>
<td>40 to 75</td>
<td></td>
<td>Porch, entry.</td>
<td>Frosted or etched glass reduces glare. Open bottom lights steps. If only one bracket is used, place it on lock side of door.</td>
</tr>
</tbody>
</table>
Indirect and special effect lighting can be obtained by the use of cornice, valance and cove lighting. In all three, the source of light is entirely hidden. All of the light may be reflected on the ceiling or part may be reflected onto the wall. Fluorescent tubes are usually the light source. See figure 18.

Figure 18.

THINGS TO DO

(1) Become acquainted with the types of general lighting fixtures and determine where to use them.

(2) The club might hold an inspection tour of some building and determine what changes would improve the general lighting. The club could decide types of fixtures and method of general lighting to be used.

(3) Determine which method of general lighting is more desirable in the room selected for your project; and if possible have needed corrections made. Note: The general lighting may be improved by having the room painted, by changing bulbs, or by the use of adapter fixtures; or the lighting may be improved by the use of portable lights as discussed in the next two problems.

Problem Four

PORTABLE LIGHTS

As explained in the previous problem, there are two types of lighting: general and specific. Both types are needed. The specific light is usually a portable light. Thus, no attempt will be made to discuss other types of specific lights. The specific light should not be used alone. Rather it should be used with general lighting.

Two acceptable types of portable lamps are those which employ a diffusing bowl and those which use the harp. Most table lamps have a pipe running the full length of the stem. This pipe is threaded at both ends and held in place by nuts and washers. The top of the pipe protrudes from the base and serves as a nipple for mounting the socket. Others may have a one-piece stem and base and use a pipe nipple screwed into the top of the stem. The full length pipe is preferred. Where there is no nut on top of the pipe, the socket serves to hold the pipe in place. For a better understanding of the parts of the two types of lamps, see figure 19.
How To Judge A Portable Light

When you decide to buy or make a portable light you should keep in mind the way you will want to use it. Think of the area that needs to be lighted and the amount of light you will need there. In selecting or making a portable light, ask yourself the following four questions. If you can answer "yes" to each of them, you have a good lamp. (Portable lights used in shops and barns, such as trouble shooting lamps, should also meet these four requirements.)

Question (1) IS THE LAMP SIMPLE IN DESIGN?

A portable lamp should harmonize with the other room furnishings in every way. This means that the design must be interesting, yet not conspicuous. A good lamp will add a refined and quiet touch to the room.

Question (2) DOES THE LAMP HAVE A PROPER SHADE?

Any shade should be of material that prevents bulbs or the diffusing bowl from showing through and should be deep enough to cover the bowl and bulbs. The inside of the shade should be white or almost white so it will reflect the light to the place you want to use it. Dark linings absorb the light. A lamp that sends some light up to the ceiling or lets some through the shade helps chase away heavy shadows nearby.

The shape of the shade determines how wide the circle of light will be. A slanting shade gives a larger lighted area than a straight-sided one of the same bottom diameter. Proper shade sizes are important and vary with the type of lamp.

Question (3) DOES THE LAMP GIVE A GOOD LIGHT?

A lamp that is to be used for reading, writing, and similar purposes should not have less than a 150-watt bulb or its equivalent in a fluorescent tube. TV lamps and lamps that are to be used for general lighting purposes may have bulbs or tubes of lower wattage.

A diffusing bowl or an indirect bulb helps to eliminate shadows by directing light upward and downward as well as reducing the glare of the bulb. Diffusing discs are sometimes used on small pin-up lamps. Note: Diffusing bowls should be U shaped at the bottom and not V shaped.

The location of a portable lamp also determines if the light is a good light. The proper placing of a portable light is discussed in the next problem.

Question (4) IS THE LAMP TALL ENOUGH?

This question will not pertain to trouble shooting lamps, portable wall lamps, and similar types of lamps since their height is determined by where they are used or by where they are attached to the wall.
The lamp should be tall enough to shed light properly. Tall lamps give wider circles of light than shorter ones, but if they are too tall they may be too far away to furnish enough light on your work and the bulb may shine in your eyes or in the eyes of others in the room.

Other Things To Watch For In Portable Lamps

For safety, a lamp should be well constructed and have a base that is heavy enough to prevent tipping.

When selecting and/or making a lamp, pay attention to its dimensions and if possible try it in a location similar to the one in which you will use it.

You may have seen lamps carrying a certified tag or the initials C. L. M. This means that the lamp or the parts of the lamp have met the standards set by lighting engineers. Such standards guarantee plenty of comfortable light and safe, sturdy construction. Lamps with this certification will meet our four rules of good lighting if properly placed and if there is adequate general lighting.

Proper Placement of Lamps

A good portable light will best serve its purpose when properly placed. An excellent way to demonstrate this statement is to hold an open book close under the lamp. Then move the book slowly downward and watch the print fade. Start again, this time moving the book sideways. This shows how important it is to keep the source of light close to what you want to see. But the lamp should also be placed so you can be comfortable. Things to remember when locating a lamp are as follows:

For writing or sewing, have the lamp opposite your working hand so that your hand will not shadow your work. (Repeat demonstration pertaining to rule four in problem one.)

Place a lamp for reading beside and toward the back of your chair or sofa so light will fall on the page. The lamp will be out of your sight, too.

A table lamp placed in the center of a dining table may furnish good light for studying at the table. But if you want to sit beside the table to read, with the light coming over your shoulder, you cannot get close enough to the lamp to get good light on the page.

On an end table close to a chair or sofa, use a tall lamp if the table is low, a shorter lamp if the table is higher. A short lamp on a low table may barely light the arm of the sofa or chair. An end-table lamp gives the best light when it is as high as it can be and still shade the reader's eyes.

Good lamps can often be shared by two persons. Large floor lamps may be used this way; and so may table lamps if placed on tables of the right height to spread light to both users. All persons using the light should be able to sit comfortably as they read or work.

Listed on the following pages are some guides that can be used in determining proper placement of lamps.
Activity | What to use | Where to place it
--- | --- | ---
Reading, handsewing and similar actions - seated in an upholstered chair or davenport. | Floor lamp with 100-200-300-watt three-light bulb or 150-watt bulb. | From the center of your reading or work, measure 15 inches to the right or left. From this point, measure 26 inches at a right angle to the rear of the chair for reading or 12 inches for sewing and similar work. This locates the spot over which the center of the lamp shade should be. |

Reading, writing, drawing in straight chair at desk or table | Table lamp with 50-100-150-watt three-light bulb or 150-watt bulb. | Measure 20 inches to the right or left from center of reading material. From there measure 16 inches at right angle to the rear of the chair. Above this point on your table place the center of the lamp. |

Reading--seated in bed. | Bed lamp with 50-100-150-watt three-light bulb or 150-watt bulb. | Measure out from center of lamp shade 26 inches, then from this point measure 15 inches to the right or left at a right angle. The chair should be placed so the center of your reading matter is at this point. Centers of the two lamp shades are 30 inches apart and 17 inches in from front edge of desk. For left-handed persons the lamp is located to the right of the papers. |

Two wall lamps with 100-watt bulbs. | Locate so its center is 9 inches in from the front desk edge and 15 inches above the desk top. |

Fluorescent lamp with two 20-watt tubes. | Measure 22 inches from center of book out to side. Then measure 16 inches at right angle toward wall. Over this point is the center of the lamp. |
Activity | What to use | Where to place it
--- | --- | ---
Facial make-up at dressing table or vanity | Wall lamp with 50-100-150-watt three-light bulb or 150-watt bulb | Bottom of the lamp shade should be about 20 inches above the top of mattress.

Wall lamp is centered over head of bed. Bottom of shade is about 30 inches above top of mattress.

Pair of dressing table or vanity lamps with 100-watt bulbs. Height to center of shades, 15 to 16 inches if seated or 21 to 22 inches if standing. | Lamps should be located 18 inches to the right and left of the center of the mirror and 6 inches away from back of table or vanity.

Floor and/or table lamps normally in the room. Turn on low or medium. | Place television set and lamps so direct light from lamp does not fall on tube. Locate lamps some distance away at left and right of set. Avoid exceptionally bright spots of light on walls near the set. Avoid bright lamp shades. A lamp (often called TV lamp) which gives a small amount of indirect light when placed on the TV set is helpful in obtaining the desired lighting condition.

THINGS TO DO

1. Become familiar with the various types of portable lights and where to use them. This might be done by having various types of lamps at the club meeting and asking the club members to identify the types of lamps and determine their uses.

2. Judge some portable lights -- using the four questions pertaining to portable lamps as a guide.

3. Practice the placing of lamps of different kinds and observe the effects of properly placed and improperly placed lamps.

Note: This could be used in the form of a judging contest -- with someone having previously located several lamps, and the rest of the members judging which lamp is most desirably located.

If you have not done so, decide upon your lighting project activities. Then begin work immediately. Some suggestions for things you can make are a portable lamp, a study center, or a light fixture. Or you may decide to remodel some lighting article instead of making a new article. This is permissible. Plans and guides for items to make or remodel may be obtained through your county agent, your electrical dealer, your power supplier, and your College of Agriculture.
Problem Five

OTHER USES OF LIGHT

Light may be used for purposes other than for indoor lighting. For example: light may be used to help light up yards at night, for decorative purposes, to control plant growth, and to encourage animals to eat more.

Yard Lighting

Yard lights should be so placed that all the regular paths between the various buildings are lighted. A good place for an outdoor lighting fixture is a well-located wiring pole, barn, garage, or shop. For a good spread of light, put the fixture about 15 feet above the ground. If it is much higher the lighted area will be wider but you will have to use a higher wattage bulb. Also, when the bulb must be changed you will be glad if it is not too high.

Inside-frosted bulbs of at least 200-watt size in weatherproof reflectors are good for outdoor use. The reflectors are needed to direct light down and protect bulbs from rain, hail, and snow. Shallow dome reflectors give the widest spread of light; angle reflectors throw it in a definite direction.

In some sheltered spots, such as under eaves, you may prefer 150-watt projector flood lamps or reflector lamps made especially for outdoor use. They are good for lighting areas where machinery repairs are to be made, for play yards, and for protecting poultry houses, truck gardens, vineyards, or orchards from thieves. Portable flood lamps are excellent for lighting emergency jobs. Figure 20.

You should be able to control yard lights from different points. You may do this by the use of a three- or four-way switch or a magnetic relay system.

Decorative Purposes

Lights can do much to emphasize some room, color scheme, article or idea. The important thing to remember is that such lighting should not be used for reading, writing, and close work.

For those who have never decorated with light, here are some hints.

(1) Do not overdo it. Successful decorative lighting does not depend on lavish and costly displays. In fact, too big a splurge spoils the sincerity of the thought.

(2) Start with a plan. Select only those features you wish to emphasize. Then accent the high spots of each feature with light. Remember, light is a decoration in itself. A little goes a long way.

(3) If you are placing the lights outdoors, be sure to use weatherproof wiring and bulbs that are suited for outdoor purposes.

To Control Plant Growth

The light that a plant receives in a day will greatly affect its growth. For example; it has been found that for best results, African violets must receive a minimum of 16 hours of light a day. This can be obtained by exposing the plants to two lighted 40-watt bulbs located about 18 inches from the plants during the hours the plant is not receiving light from another source. (Some people expose their violets to light the entire 24 hours and receive satisfactory results.) This same situation is true of many other plants. Research shows that even field crops may benefit from the proper use of light.
To Increase Production From Livestock

Animals also need light for best results. Many farmers use lights in their chicken houses to stimulate longer activity. This added activity results in greater feed consumption and thus greater egg production.

Some farmers are placing lights around their self-feeders to encourage more feed consumption by hogs. This added consumption may result in greater meat production.

Special Lamps For Special Purposes

Bulbs have also been developed for special purposes. Some examples are:

Bactericidal lamps. Bactericidal lamps produce ultra-violet rays which kill germs. They are used by industry in walk-in coolers, meat-packing houses, and places where drugs are produced or handled. Such lamps aid in the sanitation of products and help to protect the health of the workers.

Sunlamps. Sunlamps are ultra-violet lamps too. The rays they produce tan the skin and stimulate the development of vitamin D. Sunlamps are used mainly to make up for the lack of sunlight in winter months. In the house regular portable sunlamps are often used, or the RS sunlamp bulb may be used in any conveniently located socket. Directions for use should always be followed carefully.

Heat lamps. Heat lamps produce infrared rays. In the house they give comfort to tired or aching muscles or they may be used for drying hair, melting grease in sink drains, or thawing frozen pipes. In farm buildings heat lamps are useful for drying paint on metal, warming cold motors, drying newborn livestock, treating animals, and providing heat for chicks and small-animals. They may even be used to provide warmth for a worker in a shop or to keep livestock waterers ice-free.

Lamps to attract insects. Since light shining in darkness or semi-darkness attracts many flying insects, it can be used to attract destructive ones such as moths of the European corn borer, codling moth, and hornworm. Trapping female moths that have not yet laid their eggs will help to reduce the number of crop-infesting worms they produce.

THINGS TO DO

1) If a greenhouse is located in the community, visit it or have the manager visit the club. He will be glad to explain how he uses light to aid in plant growth and development.

2) Have some 4-H member or members contact the county agent and ask about how to use light to increase egg and meat production. The member(s) can then give a report to the others at the club meeting. A farm using light in this way might be visited.

3) Continue work on lighting projects if they are not done. A report by each member on his or her progress might be in order.

4) Plan the tour for the coming meeting.
Problem Six
LIGHTING TOUR

In order to obtain a better knowledge of lighting, it is suggested that your club take a tour to observe adequate lighting for reading, studying, meal preparation, laundry, bathroom, bedroom, shop, and farm buildings. It may not be possible to observe all these lighting centers, but you should visit as many as possible.

Suggested places for tour

(1) Boys' and/or girls' project room.

(2) Modern rural or city home, school or church. (Check the lighting before the tour.)

(3) A tour of a supply company. Example: General Electric Supply Company or Westinghouse Supply in Omaha.

(4) Tour of generating plant.

THINGS TO DO

(1) Go on a lighting tour -- plans should be made in advance so that the event is a success.

(2) Complete your lighting projects.
Note: Your club may need to hold another meeting, depending upon the progress made on the various projects.