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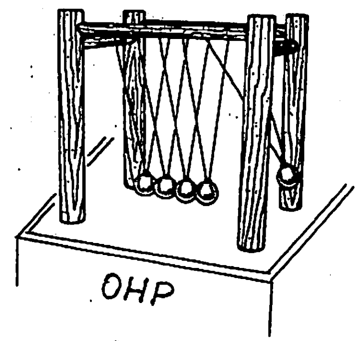
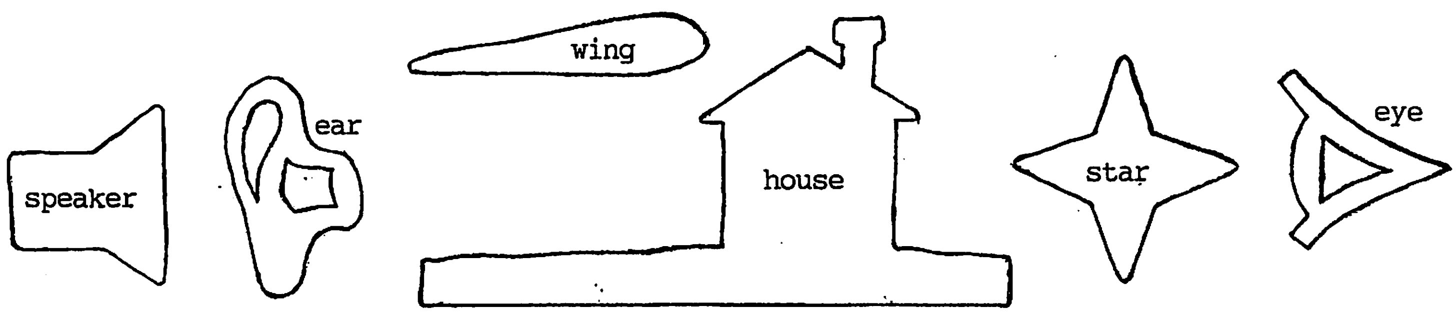
Demonstrations with the overhead projector (OHP) - The OHP is still available and is now called a "digital presenter". It is a wonderful tool for teaching physics, superior to other methods in many cases, and is limited only by one's imagination. Here is a varied collection of demos to choose from that could enhance your instruction considerably.
Several OHP demos are already well described elsewhere on this website. They are "Sunspots or relative temps.", "Electricity - Coulomb's Law", and "Magnetism and the acrylic tray". In each case, some apparatus had to be built to make the demo work well. Actually, that's true for most of the following demos which require more time and effort than money.

(a) Conservation of Momentum - Nothing can surpass the "Original Swinging Wonder" with its swinging steel spheres in demonstrating the Law of Conservation of Momentum. Even better, place the device on the OHP. Now the motion appears "linear"; you see the slight, but necessary, spacing between the spheres; and the size and focus of the spheres are just right. The simple, open, wooden stand of the Original Swinging Wonder is perfect for this demo, and the device is still available after 55+ years!



(b) The Doppler Effect - is an important concept in the study of waves that has always been difficult to explain. One possible solution, though crude, uses macrame rings (3", 5", and 7" dia.) and wooden figures cut out on a jig (scroll) saw. The position of the rings and wooden figures can be moved around to represent different situations (and speeds) for sound and light. The wooden figures (see diagrams) are cut from 3/8" thick pine so they can be handled easily with fingers. The different situations are very easy to set up with the rings and figures and can provide the students with a reasonable "picture" (understanding) of what is going on in each situation. It's not perfect but is helpful, I believe. Six basic symbols are suggested.

Diagrams: actual size



shift in pitch (freq.) sound barrier, shock wave, and sonic boom light: red & blue shifts

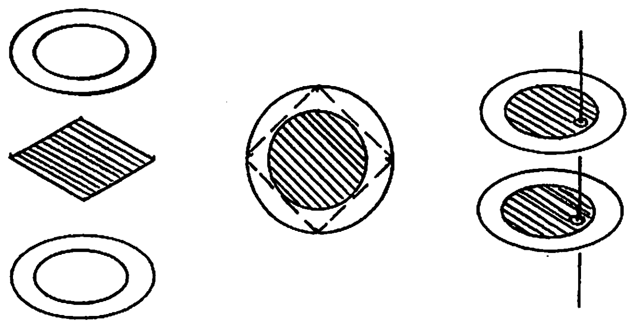
(c) Beats - Another important topic in the study of sound is "beats", or what you hear when two sources of sound have slightly different frequencies. It's actually a change in volume (loud and soft), between in and out of phase conditions, constructive and destructive. There are computer generated graphics or patterns on transparency film that can be "mixed" (overlayed) to show beats patterns; search for them on the internet or make up your own. However, a clever, but simple, alternative is to look for two hair combs with different numbers of teeth and overlay them with each other. A clear beats pattern will emerge. Better yet, locate a third comb with a still different number than the first two; thus, more possible patterns for the presentation.

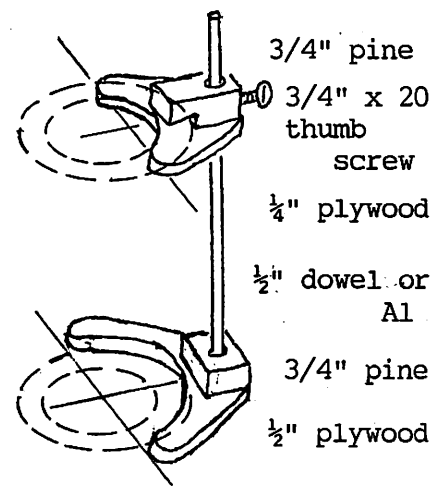
(d) Arts and Sciences - A very attractive OHP demo, but more esoteric for beginning students, is the one on crystal packing and dislocation which uses small ball bearings enclosed in a flat, acrylic case that is transparent on both sides. Such objects are usually found for sale in art museums because of their aesthetic value and penchant for stimulating the imagination. Even a small version will work well on the OHP. However, they can be made from

1/8" and ¼" acrylic sheeting and 3/32" ball bearings but require some shop skills. A full explanation of this apparatus and its construction may be found elsewhere on this website as "Crystal packing and dislocation". Much can be learned from this device, and it will never wear out!

(e) Polarization - Without a doubt, the investigation of polarization and its uses, especially in technology, is best pursued using the OHP. The effects realized are dazzling and unforgetable! Simply start with a pair of quality Polaroid filters. Try to locate sturdy 6" sq. Polaroid film and sandwich the film between two heavy cardboard rings of 5 5/8" I.D. and 8" O.D. (See diagrams.) Glue (Elmer's) the rings together to hold the film; paint the rings "flat black". Overlay and align the pair for maximum transmission on the OHP. At the bottom of each filter, "punch" or drill a small matching hole through each filter as reference "points" to be used during the demos.

Diagrams:





Place the pair on the OHP stage aligned and "crossed" (90°) to show the extremes of light transmission. From now on, one filter will rest on the stage while the second filter is suspended above it, leaving a space in between to work. For convenience, a lightweight (butterfly?) stand (see diagram) is recommended to hold (suspend) the second filter. It can be made out of scrap pine and plywood, a short wood dowel or Al rod, four small FH screws, and a thumb screw.

With the stand and filters in place and the filters aligned, place a pair of Polaroid sunglasses, bows removed, on the lower filter and slowly (carefully) rotate the glasses. (Carefully, because Polaroid film scratches easily!) Interesting result? Now align all three filters and rotate the top filter. Still interesting? Next, cross the filters at 90°; the punched holes will be at 90°. Rotate the sunglasses again. Interesting? Turns out that light's wave can be treated as a vector quantity having components. This strange rotation of light waves or photoelasticity has more than a few uses in technology as an analyzer. Here are a few simple examples that might stimulate student interest; some are quite beautiful!

1. Transparent plastic rulers that have come out of a stamping machine, especially if they have circle templets, will reveal interesting, dark, strain lines where stress has developed during the cooling of the thermoplastic. Any rulers with different patterns must have come out of different stamping machines.

Note: When stress occurs in a material, strain lines appear. These lines reveal weak areas in the material. If the area is stressed further by applying extra force or pressure, the material will likely fracture along the original strain lines where the material is weakest. Thus, before making an important product, a quality company, via R & D, will try to figure out where the strain lines will develop so that that area can be redesigned (reinforced) before production begins.

2. A standard, clear plastic petri dish and its cover are formed in injection molds from thermoplastic. When cooling, their thickness and corner shapes change slightly and strain lines develop and reveal interesting patterns and colors. Especially noticeable is the location where the plastic was injected and then snapped off when removed from the mold.

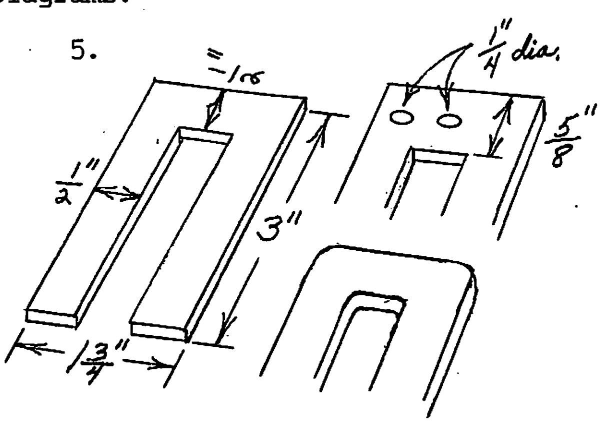
3. Natural materials show interesting phenomena under polarized light. A thin sheet of mica will reveal interesting, colorful patterns if slightly deformed (stressed). On the other hand, rotating a quartz crystal without any stress applied, will reveal that it polarizes light just like a polaroid filter. It's a natural filter because of the way its molecules arrange themselves in building up the crystal.

4. Safety glass reveals very interesting strain line patterns via polarized light. The strain lines are small, slightly rounded shapes so that when the glass shatters the pieces of glass are small and without sharp points to cause injury. "Case-hardened" (safety?) eye glasses or specially heat-treated (tempered) glass lenses reveal interesting strain lines. The lines meet, as expected, where the glass is thinnest (weakest) at the center of concave lenses worn by near-sighted people.
5. 1/8" acrylic sheeting can be cut into interesting shapes on fine-toothed table and jig (scroll) saws. Three specific shapes (see diagrams) are frequently studied, but an infinite number can be designed, cut out, and experimented with. Use your imagination. The basic design should always include a means of applying stress (a squeeze) to the model to develop the strain lines to be studied. You will quickly learn that strain lines naturally form around holes and sharp corners which eventually break open. Thus, in manufacturing, holes may be reinforced and corners are rounded to increase their strength and durability. Also, holes are more carefully positioned in quality products to offset their inherent weaknesses.

6. Instant art? For both education and fun, slowly stress (pull apart) 3/4" wide strips of clear polyethylene bag material (heavy Hefty, Ziploc, etc.) in the work space. Note the developing colors from red to blue as the stretched material gets thinner and thinner until it breaks. Stress several strips and leave the torn pieces on the bottom filter. Instant art?
7. From organic chemistry, we have learned that sugars can be optically active. This activity shows up well in polarized light. This demo requires a rotating upper filter. If necessary, construct an apparatus (see diagram) that uses a 6" lazy susan turntable bearing (Triangle Mfg. Co., Oshkosh, WI) found in any good hardware store; it will hold the filter nicely. Using an acrylic cylinder (see diagram) with an optically flat bottom, place it carefully on the bottom filter. With the OHP on, slowly pour a sugar solution into the cylinder while rotating the upper filter. Note the constantly changing colors as the white light is manipulated by the sugar molecules; another beautiful sight!
8. The transparent tape "wheel" (see diagram) used to be a favorite study with polarized light. More recently finding the right kind of tape to make the "wheel" has been a major problem. You will have to buy and experiment with different brands of tape to find the one (if any) that performs well. Also, you need a second lazy susan apparatus (see diagram) to show it at its best. The "wheel" is made by laying down cellophane tape on transparency film like spokes in a wheel with different thicknesses as you go out from the center (hub). Place the many spokes close together with much overlaping; the overlaping reveals the colors! The changing colors are almost psychedelic! Have fun!

Diagrams:

5.



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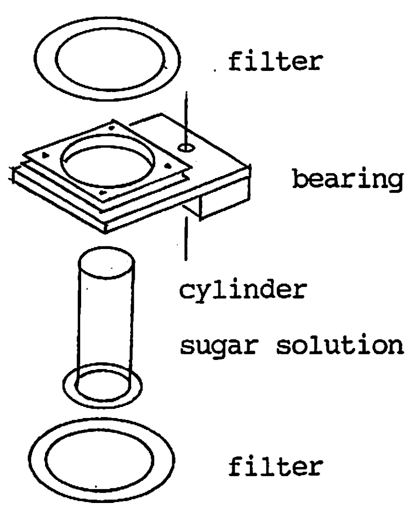

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