

DOOR LOCK

OBJECTIVE:

You will understand and demonstrate how levers are used in a lever door lock.

INTRODUCTION:

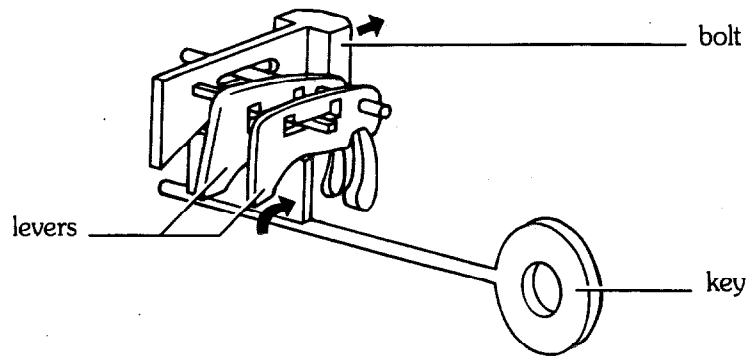
A lock enables a door, lid, or movable property to be secured against unauthorized entry or removal. In prehistoric times, before locks were invented, secure places to store valuables would have included hollow tree trunks, the recesses of caves, or pits dug in the ground and covered over. Later, cords and ropes were used to fasten doors in various ways. A wooden latch used to secure a door on the inside could be lifted or drawn back from the outside by a cord passed through a hole in the door. Preventing someone from opening the door from the outside required only pulling in the cord.

The earliest locks date back to ancient Egypt in about 2000 BC; these were used to secure cases holding mummified remains. The later development of lock mechanisms with keys was driven by two main considerations: good security and convenience. It made selective access possible—those with the right key could gain entry; those without could not.

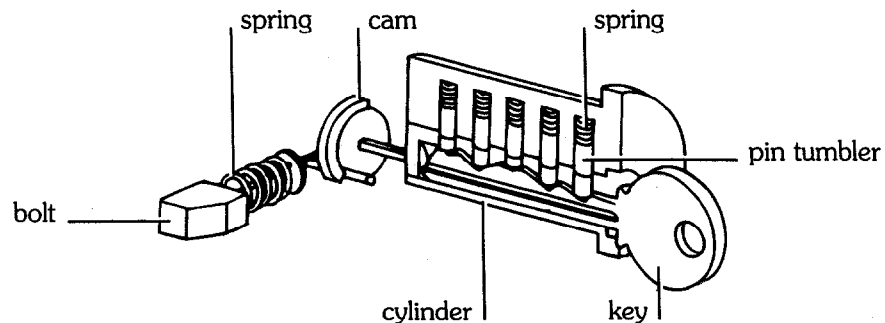
There are two main designs of lock. The easier to manufacture—and, in general, the easiest to pick—is the lever lock. In this type, a key cut to a precise shape engages in the lock and when turned, it moves the bolt (see figure 1a). The more sophisticated and secure cylinder lock has a number of lever tumblers that are raised to the right level by the key in the lock, so allowing the key to be turned and the bolt to be moved (see figure 1b). Surprisingly, the early Egyptian locks and keys were of the cylinder type, but using movable pins. In this investigation you will construct a simple lever lock and a key that will be used to lever one or two bolts into position. In practice, most lever locks have levers (tumblers) that move the bolt across, aided by one or more springs. In this way, without much effort, a relatively small key can be used to move a heavy bolt.

Figure 1

a Lever lock and key



b Cylinder lock and key



TIME NEEDED:

1 hour

MATERIALS:

2 lengths of 2 in. x 10 in. x 1/4 in. two-ply corrugated cardboard
6 in. x 8 in. x 1/4 in. two-ply corrugated cardboard
4 wooden matchsticks, with heads removed
6-in. length of 1/2-in.-diameter dowel
3/4 in. x 1/2 in. single-ply corrugated cardboard
glue
transparent tape

X-acto® knife
cutting board
drill (electric or battery operated)
1/2-in. (15mm) and 3/4-in. (20mm) drill bits
woodworking bench
awl with 1mm point
pencil
ruler
lever door lock and matching key
cylinder door lock and matching key

Note: You will need a source of electricity—e.g. a wall outlet—if using an electric drill.

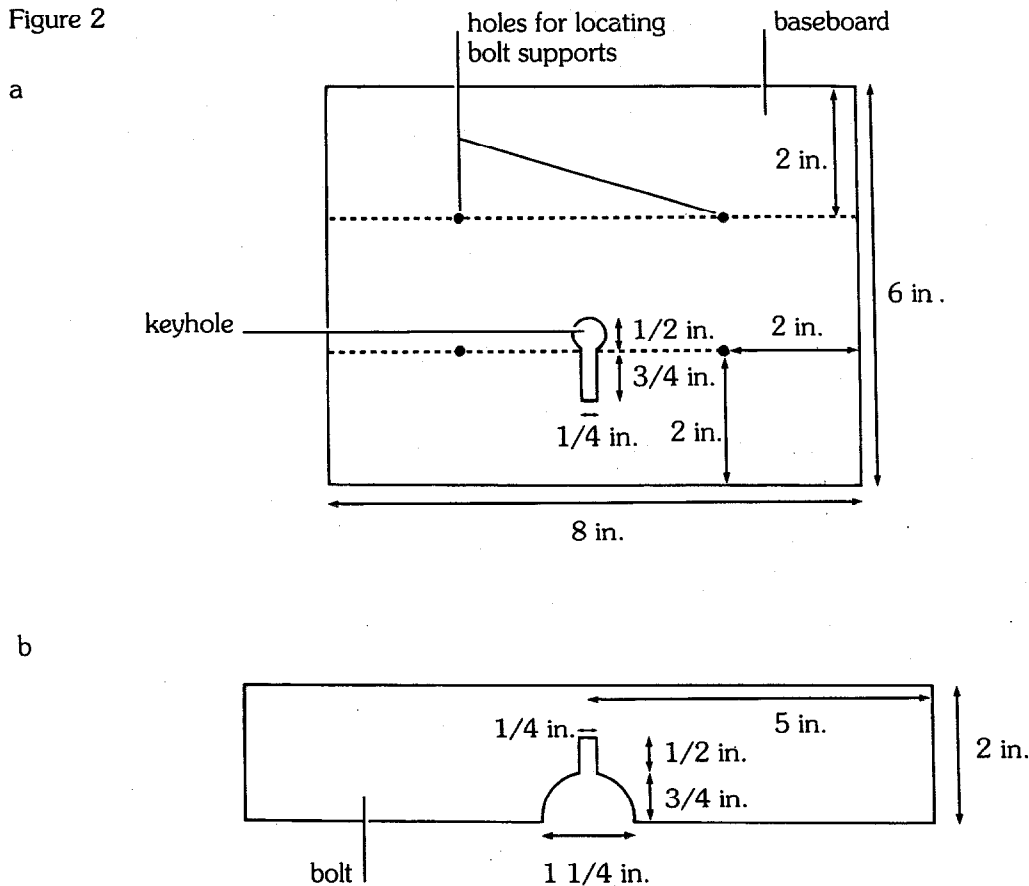
Safety Precautions

Adult supervision required. Please read and copy the safety precautions at the beginning of this book. Be careful when making holes in the cardboard.

PROCEDURE:

1. Use a pencil and ruler to mark on the 6 in. x 8 in. x 1/4 in. piece of cardboard (the baseboard) the positions for the keyhole and bolt supports (see figure 2a). First, divide the baseboard into three sections lengthways, each 2 in. wide. Then, along the two parallel lines you have drawn, mark a point 2 in. from each short side. These are the positions for the bolt supports. Place the keyhole in the center of the lower parallel line, as shown in figure 2a.

Figure 2



2. Working on the workbench, use the 1/2-in. drill bit to drill the round part of the keyhole in the baseboard to a diameter of 1/2 in. Using the awl, make four small holes at the positions of the bolt supports.
3. Glue the four matchsticks into the holes for the bolt supports.
4. Use the X-acto® knife to carefully cut a notch 1/4in. wide and 3/4in. long below the round part of the keyhole (see figure 2a). The keyhole is now complete.
5. Use the X-acto® knife to cut a notch in one of the 2 in. x 10 in. x 1/4 in. pieces of cardboard (the bolt) to the precise shape shown in figure 2b.
6. To complete the lock, place the bolt in position, resting on the bolt supports, so that the bolt notch is directly above the keyhole as shown in figure 3.
7. To make the key, glue the 3/4 in. x 1/2 in. piece of corrugated cardboard to one end of the dowel as shown in figure 4. Use tape to help secure the cardboard to the dowel. The dowel is the pin of the key, and the cardboard is the bit.

Figure 3

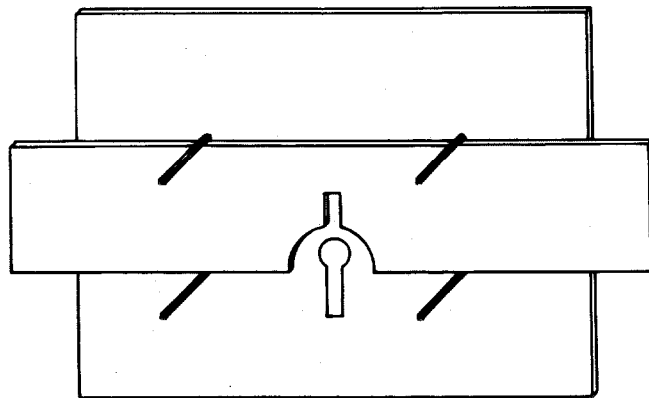
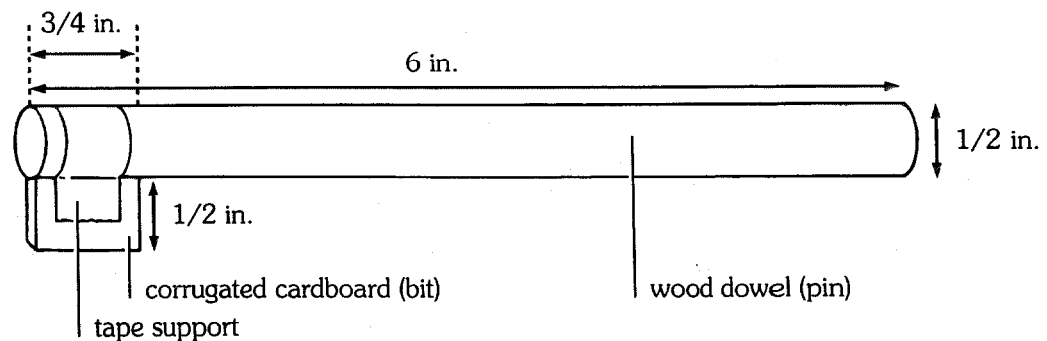


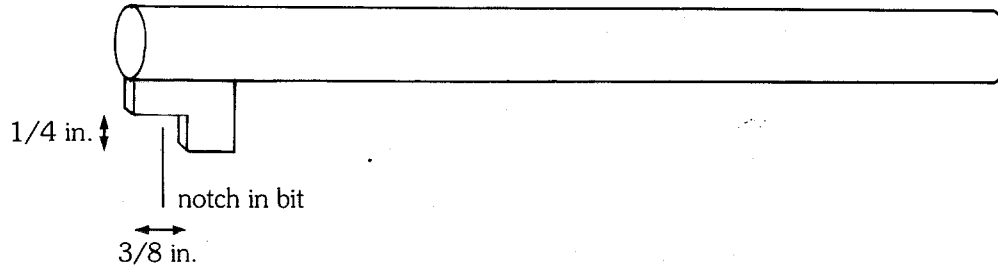
Figure 4



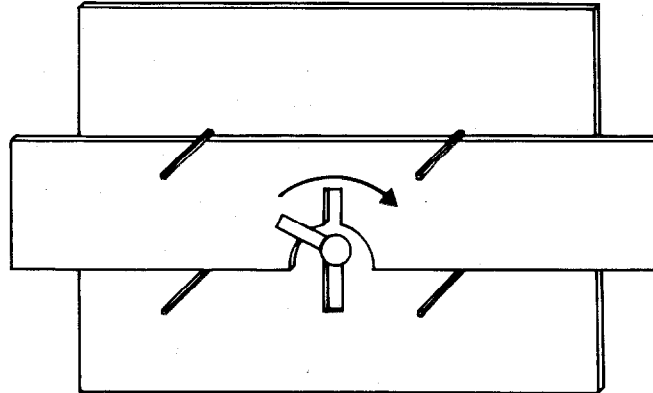
8. To operate the lock, insert the key into the keyhole from the front (the side without the bolt) and turn it. Doing so will move the bolt. Rotating the key in the opposite direction will cause the bolt to move back. Observe closely how the bolt is moved by the action of the key against it.
9. To demonstrate a method of producing a more secure lock, construct a second bolt to place alongside the first. Begin by cutting a 1/4-in.-deep, 3/8-in.-long notch in the key (see figure 5a). Insert the key in the lock so that the notch extends beyond the original bolt. Turn the key and observe the arc described by the notch of the key (see figure 5b).
10. Now design the second bolt, using your observations in step 9 to determine the shape of the notch required for it. Cut this notch in the second piece of 2 in. x 10 in. x 1/4 in. cardboard (the second bolt). Place the second bolt alongside the first, resting on the bolt supports, and check that the key now operates both bolts. If the key does not operate the second bolt, locate the fault. If the fault is the shape of the notch in the second bolt, you may have to alter the notch shape or cut an entirely new notch somewhere else on the bolt.

Figure 5

a



b



ANALYSIS:

1. Compare your simple lock and key with those found in a standard lever lock in a door. The two bolts of your lock act as levers as well. In a standard lever lock the levers and bolt (usually one) are separate. The key engages with one or more levers and raises and moves them so that they, in turn, move the bolt across (see figure 1a). The number of projections on the key matches the number of levers in the lock. How many levers does your standard door lock have?
2. Examine the key of a lever lock. In what ways is this key designed to minimize the chances of the lock being picked?
3. Most lever locks can be operated from either side of the door. What bearing does this have on the design of the key and lock?
4. Look at the lock and key of a cylinder lock. What are the advantages of this type of lock over a lever lock? What are the disadvantages?

OUR FINDINGS:

Click on above link to see what we found.

SPECIAL SAFETY NOTE TO INVESTIGATORS

Each invention includes any special safety precautions that are relevant to that particular project. These do not include all of the basic safety precautions that are necessary whenever you are working on a scientific investigation. For this reason, it is absolutely necessary that you read, copy, and remain mindful of the General Safety Precautions that follow this note.

Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly when you are constructing or demonstrating a model invention. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Always prepare for unexpected dangers by following basic safety guidelines the *entire* time you are carrying out the project, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual projects. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note: The book assumes that you will read the safety precautions that follow, as well as those in the box within each project you are preparing to perform, and that you will *remember* them. Except in rare instances, these precautions will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say **BE CAREFUL WITH HOT LIQUIDS** or **DON'T CUT YOURSELF WITH THE KNIFE** does not mean that you should be careless when simmering water or stripping an electrical wire. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it.

If you ever have a question about whether a procedure or material is dangerous, wait to perform it until you find out for sure that it is safe.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while carrying out these projects. Be sure to check the individual projects in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

PREPARING:

- Clear all surfaces before beginning projects
- Read the instructions before you start
- Know the hazards of the procedures and anticipate dangers

PROTECTING YOURSELF:

- Follow the directions step-by-step; do only one project at a time
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eye wash, and first-aid kit
- Make sure there is adequate ventilation
- Do not horseplay
- Wear an apron and goggles
- Do not wear contact lenses, open shoes, loose clothing, or loose hair
- Keep floor and work space neat, clean, and dry
- Clean up spills immediately
- Never eat, drink, or smoke in laboratory or work space
- Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

USING EQUIPMENT WITH CARE:

- Set up apparatus far from the edge of the desk or bench
- Use knives and other sharp or pointed instruments with caution
- Pull plugs, not cords, when removing electrical plugs
- Clean glassware before and after use
- Check glassware for scratches, cracks, and sharp edges
- Clean up broken glassware immediately
- Do not touch metal conductors
- Use only low voltage and current materials such as lantern batteries
- Be careful when using stepstools, chairs, and ladders
- Never look directly at the sun with your observation devices

USING CHEMICALS:

- Never taste or inhale chemicals
- Label all bottles and apparatus containing chemicals
- Read labels carefully
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves)
- Do not touch chemical solutions
- Wash hands before and after using solutions
- Wipe up spills thoroughly

HEATING SUBSTANCES:

- Use goggles, apron, and gloves when boiling water
- Keep your face away from test tubes and beakers
- Never leave apparatus unattended
- Use safety tongs and heat-resistant mittens
- Turn off hot plates, bunsen burners, and gas when you are done
- Keep flammable substances away from heat
- Have fire extinguisher on hand

FINISHING UP:

- Thoroughly clean your work area and glassware
- Be careful not to return chemicals or contaminated reagents to the wrong containers
- Don't dispose of materials in the sink unless instructed to do so
- Wash your hands
- Clean up all residue and put in proper containers for disposal
- Dispose of all chemicals according to all local, state, and federal laws

BE SAFETY CONSCIOUS AT ALL TIMES