# Bell Jar & Ringer

P7-6500

## BACKGROUND:

**What is sound?**

Sound is produced when vibrations travel through a medium in longitudinal waves. The medium can be solid, liquid, or gas. Sound travels faster through more dense materials. (This is why characters in old western movies sometimes listen to railroad tracks. The vibrations from the train travel through the tracks faster than they travel through the air.)

The frequency of the vibrations determines the pitch of the sound. High frequency sounds have high pitches, and vice-versa. The amplitude of the vibrations determine the loudness of the sound. High-amplitude vibrations sound loud, and low-amplitude vibrations sound soft. Amplifiers (even simple devices like the cone on an old-fashioned phonograph) can increase the amplitude of vibrations so that human ears can more easily detect them.

Since sound is a physical vibration, it requires a medium to travel. If there is no transmission medium, the sound will not propagate. Since residents of earth are always surrounded by the gases in the atmosphere, it can be difficult to demonstrate this in an ordinary laboratory.

## ASSEMBLY AND OPERATION:

1. Always inspect your Bell Jar and Base Plate for any cracks or weakness before use, as this can cause a dangerous failure of the apparatus.

2. Test the electric bell by inserting 2 AA batteries and turning on the switch located in the lower right corner of the bell frame. Let students hear how loud it is when outside the jar. Turn the ringer off.

3. Attach the ringer to the apparatus by inserting the two screws through the rubber “feet” of the ringer frame and into the base plate. (This rubber mounting reduces the vibrations that are transferred directly from the ringer to the base plate.) Turn the ringer on.

4. Place the gasket on the base plate, and lower the bell jar so that it makes a good seal. (Note: a *Bell Jar* is named for its bell shape, and can be used for many other experiments involving air pressure and vacuum.)

5. Listen again for the sound of the ringing electric bell. It may be softer than before, but still clearly audible.

6. Attach the included hose between the base plate and vacuum pump and turn it on. (Be sure to make sure that the valve on the base plate is in the open position.) When the pressure reaches a low point, turn the pump off and close the valve. Listen for the bell. It should be barely audible, if at all. Students can look inside and see that the ringer is still moving. Since the transmitting medium around the bell has been removed, however, the sound does not travel to their ears. (Note: Depending on the strength of your vacuum pump, some sound may still be heard, but it will be noticeably reduced. Also, if the vibrations are not completely isolated from the solid parts of the apparatus [the base plate and the jar], some sound may be transmitted through them.)

7. Turn the release valve to reintroduce air into the jar. (The sound will get louder again.) Lift the bell jar. Turn off the ringer.

## ADDITIONAL EXPERIMENTS:

1. Investigate **gas laws**. Use small balloons and marshmallows to demonstrate the effect Boyle's Law (the relationship between pressure and volume).

2. Repeat the gas laws experiment with liquids and solids, showing that liquids and solids have a definite volume.

3. Investigate **vapor pressure**. Place a beaker of hot water in the bell jar and reduce the pressure. You may observe the water boiling at the reduced pressure. (Note – you may first observe bubbles that are not water vapor, but rather dissolved gases that escape before the water boils.) Check the temperature of the water after boiling. It will be cooler!

## KIT CONTENTS:

- Bell Jar
- Base plate
- Gasket
- Hose
- Battery-powered ringer bell

**REQUIRED FOR USE:**

- **Electric Vacuum Pump** (P7-6502)

## RELATED PRODUCTS:

**Vacuum Pumper and Chamber** (P1-2140)

**Elasticity of Gases** (P1-2075)