

## Alternate CBL Instructions

### Electromagnetic Wave Shielding

#### Safety Precautions



- Always wear safety goggles and a lab apron.
- Wears gloves when bending or handling the wire screen.
- Use caution when working with staples to avoid puncturing skin.
- Use caution when plugging in, using, or unplugging the CBL 2 unit's power supply.

#### Materials

two steel bread-baking pans

steel plumbing pipe, 12-in  $\times$  1 1/2-in diameter (or 3/4-in diameter)

static shielding bag (type used to protect computer parts)

aluminum foil

masking tape

metal screen

stapler

two small cardboard boxes

TI graphing calculator

link cable

CBL 2 unit

DataMate program

magnetic field sensor

#### Procedure

1. Prepare an aluminum covered box. Cover the outside of the small cardboard box and its lid with aluminum foil. Cover the lid separately from the rest of the box so the lid can be removed and replaced.
2. Prepare the wire screen box. Fold a piece of wire screen so that it forms a four-sided box shape with open ends. Use staples to hold connecting edges of the screen together. Make sure the wire box is large enough to fit the magnetic field sensor inside. Next, cut a piece of wire screen to fit over each end. Staple one of these pieces in place over one of the ends, making sure to leave no openings. Then staple one edge of the remaining piece of wire screen to the other end of the wire box. This piece of screen will act as a door that can be opened and closed.
3. Connect the magnetic field sensor to Channel 1 of the CBL 2 unit. Connect the CBL 2 unit to the graphing calculator using a link cable. Firmly press the ends of the link cable into each unit. Place the magnetic field sensor toggle switch to the LOW  $\times 10$  setting. NOTE: this is a modified lab based on use of a magnetic field probe rather than a device receiving an electromagnetic wave.
4. Review the similarity and differences between the magnetic fields and electromagnetic waves.

5. Turn on the graphing calculator. Start the DataMate program. Press CLEAR to reset the application program. The CBL 2 unit should auto ID the magnetic field sensor and the graphing calculator should begin displaying magnetic field values in millitesla. Observe the magnetic field readings as you move the probe around.
6. Hold the magnetic field sensor next to your body and cover it with your arms. Observe the field strength. Record your observations.
7. Place the sensor inside a cardboard box and put the lid on the box. Observe the reading on the graphing calculator. Record your observations.
8. Repeat step 7 five additional times using the aluminum foil covered box, the static shielding bag, the screen box, placing the sensor inside a steel baking pan and the placing a second steel pan on top of it, and finally inside a steel pipe. Record your observations.

### **Alternate lab procedure, using a CBL unit**

1. Prepare an aluminum-covered box. Cover the outside of the small cardboard box and its lid with aluminum foil. Cover the lid separately from the rest of the box so the lid can be removed and replaced.
2. Prepare the wire screen box. Fold a piece of wire screen so that it forms a four-sided box shape with open ends. Use staples to hold connecting edges of the screen together. Make sure the wire box is large enough to fit the magnetic field sensor inside. Next, cut a piece of wire screen to fit over each end. Staple one of these pieces in place over one of the ends, making sure to leave no openings. Then staple one edge of the remaining piece of wire screen to the other end of the wire box. This piece of screen will act as a door that can be opened and closed.
3. Connect the magnetic field sensor to Channel 1 of the CBL unit. Connect the CBL unit to the graphing calculator using a link cable. Firmly press the ends of the link cable into each unit. Place the magnetic field sensor toggle switch to the LOW  $\times 10$  setting. NOTE: this is a modified lab based on use of a magnetic field probe rather than a device receiving an electromagnetic wave.
4. Review the similarity and differences between the magnetic fields and electromagnetic waves.
5. Turn on the CBL unit and the graphing calculator. Start the PHYSICS program. From the MAIN MENU select SET UP PROBES. Enter ONE as the number of probes. From the SELECT PROBE menu, select MAGNETIC FIELD. Press ENTER to continue. Under the CALIBRATION menu select USE STORED. Next, on the MG FIELD SETTING menu, select LOW(MTESLA). The program will now return to the MAIN MENU.
6. From the MAIN MENU select COLLECT DATA. On the DATA COLLECTION screen select MONITOR INPUT. Observe the magnetic field readings as you move the probe around.
7. Hold the magnetic field sensor next to your body and cover it with your arms. Observe the field strength. Record your observations.

8. Place the sensor probe inside a cardboard box and put the lid on the box. Observe the reading on the graphing calculator. Record your observations.
9. Repeat step 8 five additional times using the aluminum foil covered box, the static shielding bag, the screen box, placing the sensor inside a steel baking pan and the placing a second steel pan on top of it, and finally inside a steel pipe. Record your observations.