

How Does Air Turbulence Affect a Light?

Time Required: 1 hour

Grade Level: High School

Summary:

When you talk, your breath makes the air around your mouth move. However, you probably are not usually aware of such tiny breezes. Using a sensitive photo-detector, we can make even minor air turbulence in the air detectable. Can you think of some uses for the device you will be making?

Materials:

Diode laser

Battery holder (2 "D" cells for 3 volt power supply)

Photo-detector

Amplifier-speaker

Mini-phone jack

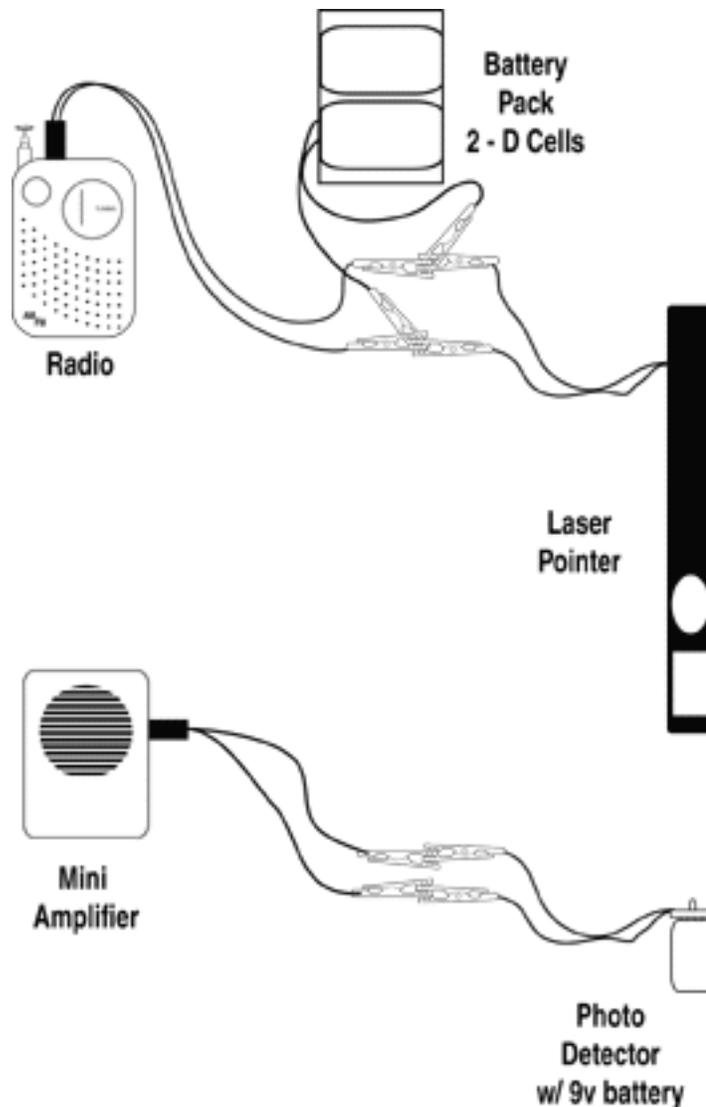
4 Alligator clip leads

Optional: Multimeter and leads (DMM=digital multimeter)

Optional: Oscilloscope

Assembly:

1. To extend the length of time that the laser pointer will operate, remove the AAA batteries in the pointer provided in your kit, and connect the laser pointer to a battery pack containing two D-cell batteries. This is done by opening the laser pointer and connecting an alligator clip lead in the laser at the positive (+) internal battery terminal, and then connecting that clip lead to the positive (+) terminal on the external battery pack. Repeat this procedure for the negative (-) terminal. Close the laser pointer. Please note that the on/off button has been altered so that the laser will be on whenever the external batteries are connected. To turn off the laser disconnect one of the leads from the battery pack.



2. Now it is time to modulate the beam by attaching it to a sound generating device (oscillator, radio, cassette, CD, etc.). Insert a mini phone jack cable, a special plug with a long, silver post and two wire leads, into the earphone plug of the radio included in your kit. Make this connection now.
3. Now connect the photo detector to a 9-volt battery. The photo detector is a light sensitive diode with two wires extending from it. Here it acts like a catcher's glove, you will use it to catch the light from the laser and send the sound found on the light beam to the amplifier/speaker where it can be heard. Using clip leads connect the detector to a mini phone jack as you did with the radio. Plug the phone jack into the input receptacle in the amplifier speaker included in your kit.
4. You are now ready to modulate the laser light and send sound across the laser beam.

To Do and Notice:

1. For this device to work, the laser beam must be aimed directly towards the photo detector. Line up the laser beam on the diode of the photo-detector.
2. Turn on the amplifier-speaker and set the volume approximately half way up.
3. Put your ear near the speaker and blow your breath somewhere between the laser and the photo-detector. Listen for the sound of your breath from the speaker. It should be a crackling sound. If

- you do not hear your breath, try repositioning the laser beam. It should fall very slightly to one side of the photo-detector.
4. Tap the desk. Did you hear a response from the speaker? Try speaking, so that your breath blows across the beam. (CAUTION: never look directly into the laser beam). Clap your hands beside the beam. Can your partner hear all these air movements from the speaker?
 5. Now turn on the radio. You will be able to hear the radio from the speaker.
 6. Place a lighted candle under the laser beam. You should be able to hear a distortion in the sounds coming from the speaker.

What Is Going On:

When you disturb the air, you affect the laser beam. The photo-detector picks up the disturbance, which is amplified by the amplifier-speaker. These results in the crackling sound when you blew air into the path of the beam before you turned on the radio. The heat from the candle caused the air to move distorting the laser light and radio sounds when you placed the candle under the laser beam.

Etcetera:

Students are not going to have an easy time, attaching all the components of this complicated set-up, unless you go over the steps with them slowly and carefully. Many students will understand the procedure more easily, if you can explain the diagram to them, as they trace it, step by step.

Having an oscilloscope is very useful, as then you can demonstrate the changes in voltage in a visible way. Perhaps you can ask around your school, or ask your students, so that you may have one available on the day of the activity.

The type of multimeter found in the kit is a digital multimeter or DMM. Because it can measure voltage, current and resistance, it is called a multimeter.