Name(s): _____ Date: _____ Period: _____

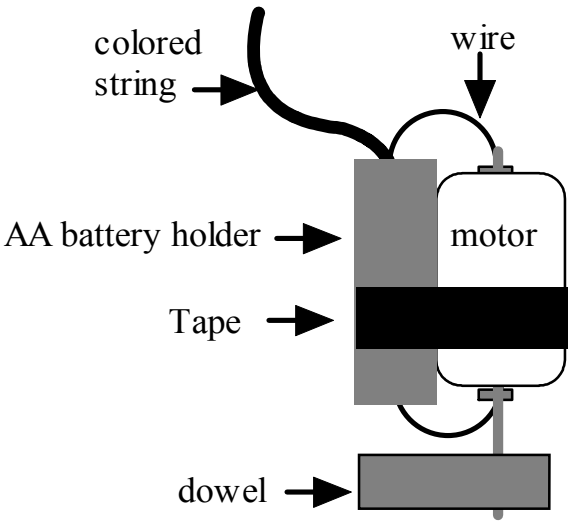
ACTIVITY #9: STANDING WAVE DEMONSTRATOR

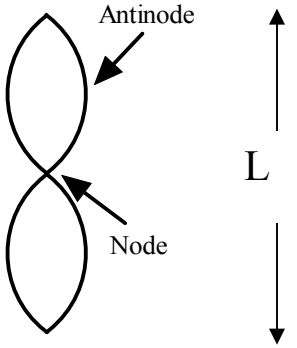
Description:

It takes a little bit of time to make this demonstration equipment, but it will last for years.

Hold the apparatus by the end of the brightly colored string. Connect the battery so that the motor runs. The apparatus will vibrate causing the string to vibrate. Adjust the length of the string until a standing wave is produced. Changing the length will produce standing waves with different frequencies and therefore a different number of loops on the string. See how many loops can be produced.

The loops can be viewed with a stroboscope, or by holding the apparatus in front of the blue screen on a television screen will cause it to strobe also.





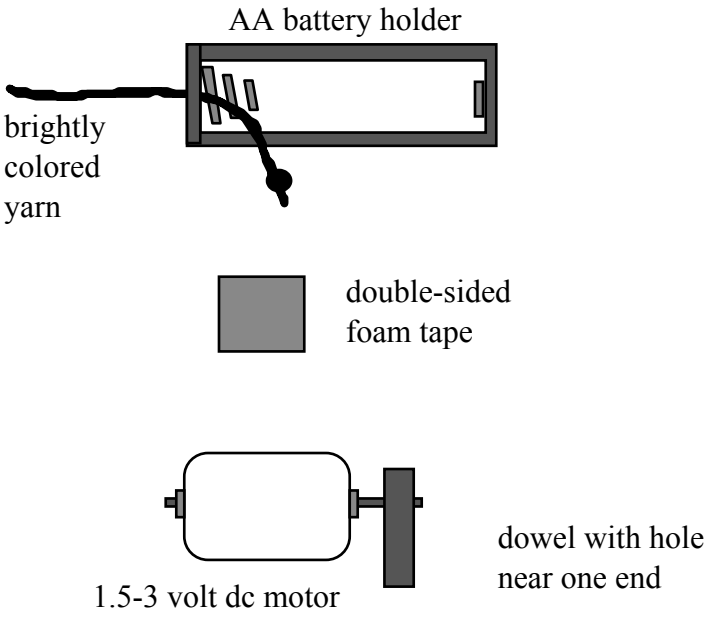
Materials:

- ❑ Small electric motor 1.5 volts (for quantitative data use a 1.5 – 6 volt motor)
- ❑ AA battery and battery holder (for quantitative data use 4 AA batteries and three dummy cells of Aluminum, an optional 100 Ω resistor and a switch)
- ❑ 1.5 length of 3/8 inch dowel or lead fishing weight.
- ❑ About one meter length of string or yarn (brightly colored cord shows better)
- ❑ Insulated wire
- ❑ Electrical or other tape

Construction:

1. Cut the dowel to a length of about 1.25 inches. Drill a hole cross-wise through the dowel closer to one end. The size of the hole should be just smaller than the shaft of the motor.
2. Press the dowel onto the shaft of the motor.
3. Feed the yarn through the end of the battery holder where the spring is located. Tie a knot in the yarn, pull back so the yarn is inside the spring and doesn't interfere with electrical contact. On a 4-cell battery holder there is a hole in one end in the center of the holder that does not interfere with the electrical contact.

4. Fasten the motor to the battery holder using the double-sided foam tape, hot glue or Velcro. The shaft of the motor should extend past the end of the holder so the dowel or fishing weight can turn freely without interference.
5. Use the leads from the battery holder and solder them to the contacts on the motor. You can use an on off on switch and a 100 Ω resistor. The leads should be shortened so they don't dangle.
6. Now wrap electrical tape around the motor and battery holder to secure them. Put a battery in the holder and the motor should turn freely, but create a vibration due to the off-balanced dowel or fishing weight. Without an on-off switch, grabbing it and removing the battery or dummy cell must stop the motor.



For quantitative data use a hand strobe or electric strobe and a 4-cell AA battery system. If you use an on-off switch with two speeds you can gather eight data points, without the 100 Ω or switch you can gather four data points of wavelength and corresponding frequency. Data can be graphed, linearized and analyzed.

Summing Up:

1. What happen to the number of loops on the string as the frequency is increased?

2. How are wavelength and frequency in a given medium related? What is the evidence to support your answer?

3. How did you plot the data so you get a straight line? What does the slope of this graph represent?

4. What mathematical relationship between frequency and wavelength is represented by this graph and data?