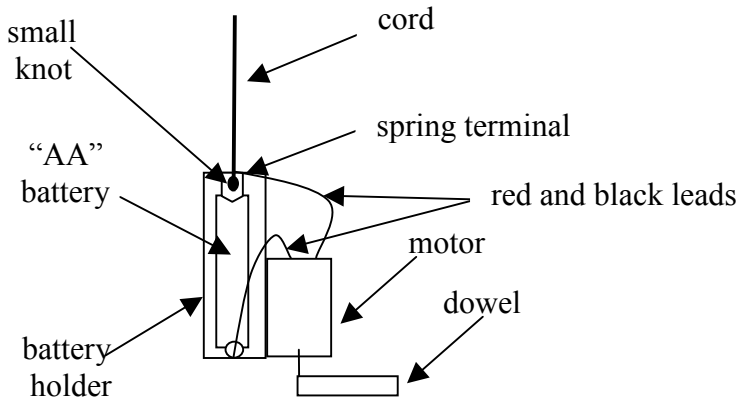
Inexpensive Standing Wave Apparatus

For about three dollars you can construct a standing wave device that may be used for demonstrations and quantitative measurements. The standing waves produced by this simple apparatus have to be witnessed to be believed!

- 1 — 1.5 volt electric motor
- 1 – "AA" battery
- 1 — ~1.5" length of 3/8" dowel rod
- 1 — ~1 meter length of string or cord
- 2 — 2" lengths insulated wire or 1 - battery holder, preferably with leads attached.
- tape (double-sided mounting tape or electrical tape)

Resources: The motor (1.5-3VDC MOTOR CAT# DCM-252) is from All Electronics at http://www.allelectronics.com/. It costs $1.15. Bulk prices are available. The AA battery holder may also be purchased at All Electronics (BH-31), but does not have pre-attached leads. I purchase a unit with leads (Model: 270-401 | Catalog #: 270-401) for $0.99 from RadioShack. Bulk prices available.

Construction Details:



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1. Form vibrator unit by attaching battery holder to motor with double-sided mounting tape or electrical tape.

2. Electrically connect the motor to the battery by soldering the 2” wires to ends of battery holder and motor posts. If you use a battery holder, chances are that the holder has leads at each end. In this case, simply solder these leads to motor posts.

3. Drill ~1/16" hole close to end of dowel rod segment. Attach dowel rod segment to motor shaft. Friction should keep dowel rod on motor shaft.

4. Tie string or cord to convenient point on vibrator unit.

5. To activate vibrator, insert battery into battery holder.

Using the Standing Wave Apparatus:

I. Demonstrating Standing Waves
- A. Connect ends of leads together to activate vibrator.
- B. Hang vibrator from string. Adjust length of string until a standing wave is obtained.
- C. To change number of anti-nodes in standing wave pattern, simply vary length of string.

II. Determining Wave Speed — Method I
- A. Establish standing wave on string.
- B. Measure distance between adjacent nodes. Multiply this distance by two to obtain wavelength of the disturbance.
- C. Use strobe light to measure frequency of wave.
- D. Calculate wave speed from $v = f \cdot \lambda$.

III. Determining Wave Speed - Method II
- A. Use balance to find mass of vibrator unit and mass of a string sample.
- B. Calculate weight of vibrator in newtons. This equals tension in string.
- C. Find linear density of string (μ = mass/length).
- D. Calculate wave speed from $v = (T/\mu)^{1/2}$