Amplification

- As sound waves travel outward from a source, they weaken. Three reasons: (1) some of their energy gets dissipated because the medium of air isn't 100% efficient. (2) The collision of air molecules converts some "shock" energy into heat energy. (If you bend a wire back and forth really fast, it will get hot. Same idea.) (3) And, the area which the wave must "cover" increases exponentially. (That's like how the surface area of a balloon increases exponentially as it is blown up. When the balloon is mostly deflated, one puff of air will make a big difference in its inflation. But when the balloon is mostly inflated, one puff won't do much at all.)

- As they weaken, the sound wave's energy (signal) gets mixed up with all the other kinds of air movements, such as ambient sound (birds, computer whirring, etc.) and air currents (breeze, wind, etc.).

- For a human to hear the sound wave and distinguish it from noise, the sound has to be loud to begin with or it has to be amplified, such as with a megaphone.

- Electrical signals weaken too, mostly from the resistance of a conductor. As signals weaken, it's harder and harder to distinguish the signal (good waves) from the noise (bad waves).

- So, we use a piece of equipment known as an amplifier to increase the strength of the signal. Amplifiers are used in electronic circuits of all types:

  - ☐ audio signal
  - ☐ TV picture signal
  - ☐ cable television signal
  - ☐ satellite uplink signal
  - ☐ laser signal (in an optical fiber)

- When signals are strong, it's pretty easy to amplify only the signal and not the background noise. But when signals get weak, they are hard to separate from background "stuff" – once we can't tell the difference between the signal and the noise, they are forever combined, and the signal is wrecked.