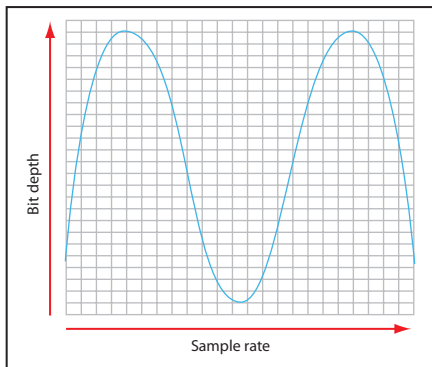## Sample rate and bit depth

Digital audio is sound that has been converted from analog sound waves into a series of bits and bytes. The conversion takes place through the use of an A/D (analog-to-digital) converter. Your computer microphone jack contains a very basic converter; audio professionals use high-end units capable of reproducing sound at a much higher level of quality and accuracy. The quality of digital audio is determined by two important factors: sample rate and bit depth.

The *sample rate* refers to the number of samples of an audio waveform that the converter digitizes in one second, and it is analogous to the resolution of a digital photo. The more samples (or pictures) captured in each second, the more accurately the waveform is represented. Although the sample rate is specified when the sound file is recorded or converted, you can adjust it down or up later. As with digital images, however, if the detail wasn't in the original file, increasing the sample rate (or resolution) will not improve it.

Always capture audio at a higher sample rate than you think you'll need. If necessary, you can downsample later to a lower sample rate, which reduces audio file size.

An audio waveform representation of sample rate and bit depth.

Bit depth determines the amount of information that each sample contains; think of it as similar to a digital photo's bit depth setting. The higher the bit depth of a photo, the wider the range of shades available to reproduce the original colors and details. In the audio world, bit depth is responsible for reproducing the amplitude (loudness) and dynamic range of an audio waveform. Low bit depth settings, such as 8 bits or less, produce poor recordings of limited quality, akin to a telephone answering machine. In contrast, a bit depth of 16 bits is sufficient for reproducing the wide range of instruments and vocals found in professionally recorded music.

For reference, audio on a commercial compact disc has a sample rate of 44.1 kHz (or 44,100 samples per second) and a bit depth of 16.

If you plan to record your own audio, pay attention to the sample rate and bit depth settings in your software and consider what they'll mean to the quality of the original sound. Mid- to professional–level audio applications, such as Avid Pro Tools, Steinberg's Cubase or Nuendo, Apple Logic, and Adobe Soundbooth all provide a range of options and tools for recording, importing, editing, and exporting digital audio into a variety of formats. If you'd prefer to let someone else do the recording, you can find many royalty–free sound effects and loops online in a variety of formats and quality settings.

Editing your audio

Although you can perform basic editing and trimming in Flash, to conserve space you should edit your sound files to some degree before importing them. Large audio files sitting in your library can bloat your Flash document (.fla file) unnecessarily. Why import unwanted, extra audio that you know will never be used in your movie?

If you need a basic sound–editing application, your choices range from low–cost shareware to full-featured professional programs. If you are creating original audio for your movie, consider an application that at least lets you trim, cut, copy, and paste, as well as export a variety of popular file formats. (You'll learn about Flash's built-in editing controls later in the lesson.)
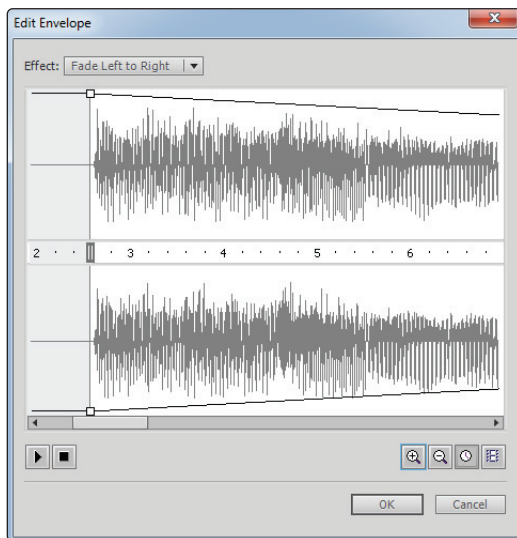
Flash's Edit window provides basic trimming, pan effects, and volume editing.

Mono or stereo

The nature of your source audio will determine whether you should stick with mono or stereo channels for your final output. Single-channel mono audio is a suitable choice for a solo recording of narration or voice. If you are working with prerecorded music or sound effects that pan from left to right, stereo is the best choice; with mono recording, you may lose a great deal of the perspective and placement (this is especially true with music). Keep in mind that stereo files include two channels (left and right), and will often take up twice as much storage space as a mono sound file at the same settings. Whether you record in mono or stereo, Flash has a series of built-in effects, such as fades and stereo effects, which you can apply to any sound you import.
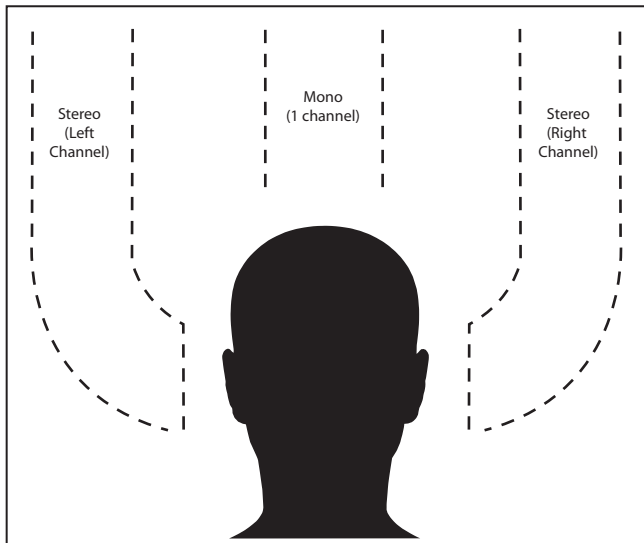
Mono reproduces audio in a single channel, while stereo does it in two channels.

Audio file formats

Flash imports three common file formats: Windows .wav, Mac OS .aiff, and .mp3. If you have QuickTime installed, you can also import additional audio file formats such as Avid's Sound Designer II format. The .mp3 format differs slightly from the others because it compresses audio to facilitate file exchange and streaming over the Web. In addition, .mp3 files use a system of Kbps (kilobits per second) to determine overall quality. The average is 128 Kbps, but you can encode at a much higher level if your software supports it. For the highest quality, keep your source .mp3 files within the 128 to 192 Kbps range.

Which file format is the right one? The answer largely depends on your operating system, as well as the software you use to create and export audio. No matter which file format you start with, Flash performs its own compression on audio included in your movies and converts all the audio in your final .swf file to .mp3 format. You can set specific quality parameters in the Publish settings for your movie.