I’ve been home recording for nearly 20 years, slowly becoming more knowledgeable. I’m not a professional and I’ve never actually been in a professional studio. I don’t play in bands or play music professionally. Which makes me...

AN EXPERT

Franklin Walther
Digital Services Librarian
Mill Valley Public Library
Mill Valley, California
USA, Earth
fwalther@cityofmillvalley.org
I want to record. Do I need one of these things?

No. I mean, if you happen to have a multi-hundred-thousand-dollar console like this SSL 9000 series, good for you.

Fortunately, the most important elements of this beautiful behemoth are available in much smaller - and much less expensive - packages.
From Sound to Signal

The Journey of Audio
Uh ... What Exactly *Is* Sound?

Vibrations propagating through a medium, of course! Air, water, liquid hot magma - all can carry sound. If it’s vibrating between about 20 times per second and 20,000, we can hear it! But how do we capture it?
First Stop: Microphones
The Microphone

Microphones convert sound energy into electrical energy. They can do so in a few slightly different ways.
The Microphone: Dynamic

Move a coil of wire through a magnetic field and you will induce a voltage change in the wire. This is just How the Universe Works; thank you electromagnetism.

However small, this voltage fluctuation is useable (after a lot of amplification) to represent the sound hitting the diaphragm.
The Microphone: Characteristics of Dynamics

Dynamics are **rugged**, with simple circuitry and robust components. This is one of the reasons they are favored for stage use - drop one, or smack it with a drumstick, and it will probably survive just fine.

Dynamics *generally* reproduce less detail in high frequencies, but they also tend to reject more extraneous sound than condensers (which we’ll get to).
The Microphone: Characteristics of Dynamics

Dynamics’ output typically needs a lot of gain from your preamp on quieter sources like speech - expect to crank that knob fairly high! Remember, it’s just a diaphragm wiggling past a magnet in there.
The Microphone: Ribbon

What if - go with me here - instead of a circular diaphragm, what prompted the voltage induction in a dynamic microphone was a wiggly ribbon of super-thin aluminum, tensioned ever so perfectly right?

If so, you’d have a ribbon microphone. And if you don’t know, now you know.
The Microphone: Characteristics of Ribbons

Ribbon mics typically sound “warm” and “smooth” because they’re slower to respond to transients (heck, it’s a big ol’ ribbon flapping around) and exhibit a high-frequency roll-off.

Ribbon mics, by their design, always have a figure-of-eight polar pattern - more on what that means in a moment.
The Microphone: Characteristics of Ribbons

Ribbon mics typically sound “warm” and “smooth” because they’re slower to respond to transients and exhibit a high-frequency roll-off.

Passive ribbon mics have very low output and require a lot of gain from the preamp. Like, a lot.

Ribbons are fragile. Blowing on them, blasting them with air, or throwing them around like a brute = snapped ribbon.
The Microphone: Condenser

A condenser microphone ("capacitor" microphone to Brits) works a little differently. Sound waves still hit a diaphragm and make it wiggle, but in this case, it’s wiggling nearer and farther from a polarized backplate and causing a capacitance change.

Blah blah blah fiddly electronics details, yada yada yada amplification, and we get signal!
The Microphone: Characteristics of Condensers

Condensers capture more high-end detail than other types. Their light diaphragms can move quickly and so reproduce transients more accurately.

Some also have switches to do things like

- Change polar pattern
- Apply a roll-off of low frequencies to avoid rumble
- “Pad” the input down to capture louder sources
The Microphone: Characteristics of Condensers

In order to work and polarize their backplates, condensers need power - and they will most often get it in the form of 48-volt phantom power supplied by the microphone preamp. Turn this power on or off while the microphone is connected, and preferably mute the channel when you do so in case the power coming on makes a loud THUMP.
The Microphone: Characteristics of Condensers

**Large-diaphragm condensers** are studio workhorses particularly well-suited to vocals. Their larger diaphragms tend to capture lower frequencies well, so they are also a common choice for everything from acoustic guitar to pianos to beefier strings (celli and up).

**Small-diaphragm condensers** respond faster to transients and generally reproduce the entire frequency range more evenly, although with a touch more noise. They are frequently used as drum overheads and on various acoustic instruments.
The Microphone: Polar Patterns

By means of clever baffling and perforations arranged about the capsule, microphones are more sensitive to sound directionally. Some microphones allow you to switch polar patterns.

Cardioid is most common; figure-of-eight will prove very useful in multi-mic situations, and omni captures ambience best - and avoids the **proximity effect**.
Onward to Cables!
Making the Connection

**XLR:**
“Extremely Low Resistance.” Great for long runs because even weak signals meet ... extremely low resistance.

**¼” TS or TRS:**
Also called “phone,” from the old switchboard days. All-purpose line-level carrier. 6.35 mm for the rest of the world.

**5-PIN DIN:**
Carries MIDI data - not strictly sound, so we’ll deal with it in more depth next time.
Making the Connection Some More

**RCA:**
Usually connects consumer stuff, but you’ll find it in pro audio too.

**⅛” or 3.5mm:**
Even moreso.

**OTHER RANDOM STUFF:**
All kinds of weird cables for all kinds of weird purposes.
Mr. Conductor

Although it ends in one jack, inside your audio cable are actually several conductors. There will be a metal sleeve that’s connected to ground (electronic ground, so that stray electricity has a path to return to Mother Gaia), and one or two (or sometimes more) other wires separate from each other.

Great. ... Why?
Let’s use these ¼” jacks to explain something cool. First:

- T: Tip
- R: Ring
- S: Sleeve (ground)

If a cable only has T (a “hot” signal) and S (the necessary ground), it can carry one “channel” of information. Nothing wrong with this - guitar cables do this, and all those RCA cables do too - only two conductors.

With three conductors, we now have two channels. What could we do?
One thing to do with our two conductors is to carry **two channels of audio** - right and left, so we can experience the music we love in stereo.
One thing to do with our two conductors is to carry two channels of audio - right and left, so we can experience the music we love in stereo.
Buckle up, cowboy, because this is about to get real. First: if equal but opposite-polarity signals are combined, they cancel each other. They disappear. Capisce? Okay.

A balanced connection sends a mono signal down one conductor and a polarity-inverted version of the signal down the other. Along the way, similar noise accumulates in each channel.

At the destination, the inverted signal is flipped back. When combined, the two signals, both positive, reinforce each other. The noise ...
A Direct Injection or DI box is a super useful thing to keep around. Into it you can plug a high-impedance, unbalanced instrument like an electric guitar or bass, and out of it comes a balanced connection that can travel for hundreds of feet over XLR cable with all the aforementioned anti-noise benefits.

Various DI boxes can eliminate nasty hum coming from ground loops, sum stereo signals before sending them along, and do other useful things.
And Now the PHYSICAL CHALLENGE Portion of Today’s Program

If you’re going to own cables, Hoss, you better know how to coil them properly, unless you like

- Knots
- Damaging the cable’s wires’ strands
- Spending 90% of your waking life picking apart a pile of cable spaghetti
And Now, the Preamp
Get on the Level

Puny microphone signals need to put on **serious beef** if they expect to cavort on the beach with the glistening, muscular line-level audio that sloshes around our recording equipment.

Fortunately, we have microphone **preamps** to do this job for us, and all we have to do is twist a knob!

<table>
<thead>
<tr>
<th>Mic Level</th>
<th>-60 to -40 dBV</th>
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<tbody>
<tr>
<td>Consumer Level</td>
<td>-10 dBV</td>
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<tr>
<td>Pro Level</td>
<td>+4 dBu</td>
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Remember how condenser microphones need external power in order to work? Almost any preamp you plug into will have the option, by physical button or by diving into a menu, of applying 48-volt phantom power. “Phantom” because it travels along with the audio, requiring no separate connection, and appearing, to a circuit not designed to use it, invisible.

Woah.
In Your Face with an Interface
An interface, the device that converts the audio to and from the digital realm, connects to your computer (or tablet) via one of a few different methods.
USB (Universal Serial Bus) is the most common connection method. Note that the letters above refer to just the connector. USB 2.0, 3.0, 3.1 ... the newer standards can move more data faster, but USB 2.0 is actually plenty of bandwidth to move more channels of audio than you likely need.

Thunderbolt interfaces are fewer on the market, but it’s a blazing fast connection, so go for it if your system’s got it!
Interfaces: I/O

Some interfaces are essentially a mic preamp or two with XLR and ¼” ins, one set of line outs for speakers, and a headphone port, like this Behringer UMC202.

Others bristle with ins and outs, like this Focusrite Clarett 4pre. Note the addition of MIDI in and out, multiple different line outs (that can be configured in software) as well as exotic digital in/out via ADAT optical and S/PDIF.

Many have a “Hi-Z” switch for plugging your electric guitar or bass in directly without a DI.
Interfaces: Other Features

Everybody needs their something, right? Some interfaces focus on a certain feature to set themselves apart, like the Steinberg UR-RT series, which features switchable input transformers designed by Rupert Neve.*

Some aim at being stripped-down platforms for truly pristine and excellent preamps, forsaking routing flexibility, like the Solid State Logic SSL2.

Consider what role your interface will fill in your recording, and which features you value most when selecting yours!

*Rupert Neve is a **big deal** in recording history.
Interfaces: All-in-Ones

Some devices can also record on their own to SD cards or other storage, as well as being mixers and interfaces if you choose to connect them to a computer. If you’d much rather move faders than click mice, consider something like the Zoom LiveTrak series, TASCAM’s Model series, or the RODEcaster Pro II.
USB Microphones: The Barest Possible Minimum

Look, I’m not knocking USB microphones. If you absolutely have nothing more you can spend, the Blue Yeti and the whole class of microphones it engendered are much better than just giving up. But if you can swing it, set yourself up with an extensible, expandable, more useful interface-and-mics rig.
Want to start recording without an interface, but be able to fancy up your setup with an interface down the road? “Road,” ha ha, because the microphone company RØDE recently released the NT1 5th Generation. Not only is this a renowned bang-for-the-buck mic, now you can plug it in via USB or XLR.

I’m not endorsing a certain product; there are other mics that do this; but … this one’s almost certainly the best.
Finally, Software: The DAW
This is the software that you will use to record your audio, then process and mix it. We’ll cover that business next time.

You’ll often see the free sound recording program **Audacity** recommended. I’m not super hot on Audacity. Although they’ve added the capability to apply real-time effects, I just think its interface is complicated and fugly. I think there are better places to start.

### Digital Audio Workstations

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<tr>
<th>FREE</th>
<th>$ - $$$</th>
<th>SPECIALTY</th>
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<tbody>
<tr>
<td>GarageBand</td>
<td>REAPER <em>(although you can try it free as long as you want)</em></td>
<td>Ableton Live</td>
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<tr>
<td>Cakewalk by Bandlab</td>
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<td>FL Studio</td>
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Recording: Vocals
But First: GAIN STAGING

It’s our job to bump these quiet microphone signals up to a useful level, but let’s not go crazy, okay? When you overdrive digital gear, it does decidedly not sound “warm,” “sweet,” “thick,” or in any way pleasant. It sounds like a digital buzzsaw crashing into your face.

Clipping is not good!

Record in 24-bit if you can for finer resolution in level and therefore more room to play with.

In digital recording, you should watch your levels coming in and aim for around -18 dB as your average. Of course levels will flutter higher and lower.

Err, if you must, on the side of too quiet. Better the noise floor that merely irks than the clipping that blasts your head.
Recording Vocals

Monitor yourself in **closed-back** headphones.

Give yourself lots of headroom, because the human voice is very dynamic.

Use a pop filter and police those **p**losives.

Mind the **proximity effect**.

Try the mic “looking” at your mouth, but coming from an angle.

Experiment with a mic “looking” down at you. What about up?

Find the right place to record. If you’re not in a good-sounding room (chances are you’re not), strategically deploy pillows and blankets.

Avoid being close to the walls.

But also avoid being dead center in the room.

Neither a borrower nor a lender be.

Think about where sound is bouncing (think pool bank shots) and diffuse or dampen it.
- Flat planes with hard surfaces
- Empty walls, particularly parallel
- Computer fans
- Background noise

- Absorptive and diffusive material on walls
- Upholstered furniture
- Bookshelves
- Cleverly placed absorptive panels
- Blankets & pillows
Recording Acoustic Guitar

Typically, get a large- or small-diaphragm condenser, set it up about a foot to 18 inches away, and pick the spot you want to aim for, for varying effect:

You can also record acoustic guitar in stereo, either with a spaced pair or X-Y or even mid-side. More on that next class.
The very most classic thing to do is place a dynamic instrument mic - traditionally, the Shure SM57 - right up against the grill cloth, and move around the speaker cone to get the desired sound. Or, try a ribbon or condenser a bit farther back.

Or both! But watch for phase issues. **Mics should be 3 times as far from each other as they are from the source.**
Switch out your close mic with a large-diaphragm dynamic - start a little off-center of the speaker cone and move around to taste.

This photo also shows a large-diaphragm tube condenser positioned farther away, to either blend or prefer.
Direct injection takes the signal from your bass (or guitar, or anything with a passive output) and converts it from a high-impedance signal to a low-impedance one. Without accounting for impedance, the sound will be muffled and inferior. That cannot stand!

Interfaces may have an impedance switch, or you can use an external DI box.
Recording: Instruments with Line Outs

Ah, nice. All that mishegas with the mics is out of the equation. Plug in. Work. Boom!

We still need to be aware of our levels as we go in to our interface, however. And use balanced connections where available, because why not?
Resources

INTERNETS
Bedroom Producers Blog
bedroomproducersblog.com

Home Recording Forum
homerecording.com

Recording Hacks Mic Database
recordinghacks.com/microphones

YOUTUBE
- Produce Like a Pro
- Musician on a Mission/Mastering.com
- Home Studio Corner
- SonicScoop
- Podcastage*
- Curtis Judd

DEAD TREE MEDIA
Recording magazine
Sound on Sound magazine
Bobby Owsinski’s books

THE LIBRARY!
LinkedIn Learning recording courses

*for very complete & consistent mic demos. Caveat: he is personally very annoying.
NEXT TIME

Mixing
EQ, Dynamics, Delays, Reverbs, Modulation, etc.!
Loudness & Mastering
Rendering
Podcast Hosting