**Lesson #18 – Recording & Mixing Lab**

**MICROPHONE TECHNIQUES**

* Choosing appropriate mic is only half the work
  + Placement is just as important
  + Mic placement is an art form

**PICKUP CHARACTERISTICS AS A FUNCTION OF WORKING DISTANCE**

* 4 fundamental styles of mic placement are directly related to working distance of mic
  + Distant miking
  + Close miking
  + Accent miking
  + Ambient miking

DISTANT MIC PLACEMENT

* 1 or more mics positioned at a distance of 3 ft or more from signal source
* This technique shows the following results
  + Pick up large portion of musical instrument or ensemble
  + Preserves overall tonal balance of source
  + To achieve natural tone
    - Place mic at a distance that is roughly equal to size of sound source
  + Allows room acoustic environment to be picked up w / direct sound signal
* Used to pickup large instrument ensembles (Symphony, Choir)
* Pickup relies on acoustic environment to help achieve natural, ambient sound
* Mic should be place at a distance that will get both ensembles direct sound and room acoustics
  + This balance determines…
    - Size of sound source
    - Overall volume level
    - Mic distance and placement
    - Reverberant characteristics of a room
  + Adds a live open feel to recoded sound
    - Could be a disadvantage if acoustics of venues isn’t great
* Improper or bad reflection cause muddy recordings
  + You can avoid this by…
    - Using absorptive or offset reflective panels
    - Place mic close to source and add degree of artificial ambience
* Raising the mic reduces reflection

CLOSE MIC PLACEMENT

* Micid often position 1 inch to 3 feet from sound source
* Generally resukts in…
  + A tight, present sound quality
  + Effectively excludes acoustic environment
* Only desires on-axis sound will be recorded – distant sounds won’t be picked up
* LEAKAGE
  + Instrument mic picking up sound of nearby instruments
    - Levels in phase cancellation make it more difficult to have control over volume and tonal characteristics
  + To avoid leakage try the following…
    - Place mic closer to sound source
    - Use directionsl mivd
    - Place acoustic barrier between instruments
    - Spread instruments further apart from one another
    - Use iso-booths and rooms effectively and efficiently
    - Seperation also achieved through DI boxes
* When mics are being miked close always try to put into effect the 3:1 distance rule
  + Can even experiment with the 5:1 distance rule
* If tonal balances are changed – try the following
  + Move mic along surface of sound source
  + Place mic further back from sond source to allow for wider angel
  + Change the mic
  + Equalize the signal
* If additional isolation is needed use flats and baffles

ACCENT MIC PLACEMENT

* A mic is placed within a reasonable close range to instruments within larger ensemble
* Care should be taken with placement and pickup choices
* Should only add presence to a solo sound – not have every other instrument stick out or separated

AMBIENT MIC PLACEMENT

* Places pickup at such a distance that reverberant (room sound) is equally or more prominent than the direct signal
* Often a cardioid stereo pair or crossed figure 8 pair that can be mixed into a stereo/surround production
  + Providing a natural reverb or ambience
* You can use ambient mic pickups in the following ways…
  + Live concert recording
    - Ambient mics can help restore natural reverberation that was lost when using close mikin
    - Ambient mics can be placed over audience for reactions and applauses
  + In studio recording
    - Ambient mics can add a sense of space or natural acoustics back into the sound

**STEREO MIKING TECHNIQUES**

* The use of 2 mics in order to get a coherent stereo image
* Used in either close or distant miking of single instruments or ensembles

SPACED PAIR

* Spaced mics placed infront of an instrument or ensemble in left/right way to get overall stereo sound
* Places 2of the same mics anywhere between a few feet to more than 30 ft apart
  + Uses time and amplitude cues to create stereo sound
* Drawback
  + Strong potential for phase discrepancies between 2 channels
* When mixed to mono – phase discrepancies results in various frequency response and partial cancellations in instruments or sounds

X/Y

* Uses only cues of amplitude to discriminate direction
* 2 directional mics of the same type are placed with grills close together as possible w/o touching and face at angles to each other
* Coincident pair system
* Mid-point between 2 mics pointed towards source and outputs are equally panned L/R
* Due to their proximity – rarely ever have phase cancellation
* Uses mics with cardioid polar pattern
* Uses 2 bidirectional mics that are offset by 90 degree to each other
* Excellent for pickup of overall ambience within studio/concert hall
* Good choice for picking up sources that are placed in the round

M/S

* Similar to X/Y technique
* Requires use of external transformer to work
* One of the mics capsules designated the M position pickup
  + Generally a cardioid pickup pattern faces forward toward the sound source
* S capsule is generally chosen as a figure that placed sideways to on-axis pickup
* M capsules picks up direct sound
* S capsules picks up ambient and reverberant sound
* Advantage
  + Absolute monaural compatibility
  + Allows you to vary mix of mid to side during or/and after recording
* When L/R signals are combined – side signals will be cancelled and mid signals will be accentuated
  + Record m to one track
  + Record s to one track

DECCA TREE

* Time tested, classical miking technique
  + Uses both time and amplitude cues to create coherent stereo image
* Consists of 3 omni-directional mics
  + Originally NEUMANN M50
* A L/R mic pair is placed 3 ft apart – another mic is placed 1.5 ft out in front and panned in center of stereo field
* Favoured by orchestral situations
* Commonly placed on a tall boom above and behind conductor

**SURROUND MIKING TECHNIQUES**

AMBIENT SURROUND MICS

* Simply place a spaced or coincident mic pair out in studio away from sound source
  + Can add sense of space to a group, drum set or instrument overdub

SURROUND DECCA TREE

* Places 5 mics onto a modified decca tree
  + Adds 2 rear-facing mics to the existing 3 decca tree systems
* Simpler approach
  + Place 5 cardioid mics in a circle

RECORDING DIRECT

* Signal of electric/electronic instrument can be injected directly into the console w/o mic using a DI (direct injection) box
* Produces, cleaner, more present sound
* Bypasses distorted components of head/amp combo
* Reduces leakafe into other mics by eliminating room sounds
* Serves to interface an instrument with an analog output signal to console in following ways..
  + Rudeuces instruments line level outpit to mic level for direct insertion
  + Changes unbalanced lines to balanced
  + Isolated audio signal paths between mic/line preamps (reduces hums and buzzes)
* Instruments ouput is plugged into DI box and box’s output is fed into mic pre of console

REAMPING IT IN THE MIX

* Allows you to record your guitar sounds one way and then re-record it and make new tracks with different effects
* Gives total flexiblility
* Leakage problems are reduced

**MICROPHONE PLACEMENT TECHNIQUES**

* Depends on the sound you are looking for
* Dynamic mics
  + Rugged more punchy character
* Ribbon mics
  + Mellow sound that ranges from being open and clear to slightly croony
* Condenser mics
  + Clear, present and full range sound
* Always attempt to use the GOOD RULE

**BRASS INSTRUMENTS**

TRUMPET

* Fundamental frequency ranges from E3-D6 (165 to 1175 Hz)
* Contains overtones that stretch upwards to 15 kHz
* Formats of a trumpet lie at 1 to 1.5kHz
* Using a mute dampens the frequencies
* Best to place mic slightly off bells center at a distance of 1 foot or more
* When closer placement is needed – a negative 10 to negative 20 dB can prevent input overload
* Use a windscreen to help protect diaphragm from windblasts

TROMBONE

* Most common trombone is the tenor
* Fundamental note range spanning from E2 to C5 (82 to 523 Hz)
* Produces series of complex overtones
* A single mic might be placed between 2 players
  + Combining them onto a single channel

TUBA

* Bass and double bass tubas are the lowest pitched brass/wind instruments
* Overtone structure is limited
  + Top frequencies ranges from 1.5 to 2 kHz
  + Lower frequencies are evenly dispersed
* Isn’t miked at a close distance
* Working range of 2 ft or more and slightly off-axis to the bell

FRENCH HORN

* Fundamental tones range from B1 to B5 (62 to 700 Hz)
* Effective pickup can be achieved by placing an omni- or bidirectional pickup between rear reflecting wall and instruments bell
  + Both receiving direct and reflected sound
* Pickups can also be placed in front of player

**GUITAR**

ACOUSTIC GUITAR

* Steel string acoustic guitar has a bright rich set of overtones
* A balanced pickup can often be achieved by placing a mic or (X/Y stereo pair) slightly off-axis and above or below sound hole at a distance of between 6 inches and 1 ft
* Condenser mic preferred for smooth extended freq response & excellent transient response
* Smaller classical guitar naormally strung with nylon or guts is played with the fingertips
  + Gives it a warmer, mellower sound
* To make sure instruments full range is picked up…
  + Place mic closer to center of bridge and at a distance between 6 inches and 1 foot

MIKING NEAR THE SOUND HOLE

* Sound hole serves as a bass port that resonates at lower frequencies (80 – 100 Hz)
* Miking close to the sound hole often popular on stage or around high acoustic levels
* To achieve a more natural pickup – mics output can be rolled off at the lower frequencies (5 to 10 dB @100 Hz)

SURROUND GUITAR MIKING

* Effective way to translate an acoustic guitar to the wide stage of surround is to record guitar using X/Y or spaces techniques stereo
  + Panned front L/R
  + Pant guitars electric pickup to rear center of surround field
* Extra ambient mics can also be used in an all-acoustic session

THE ELECTRIC GUITAR

* Fundamentals of average 22 fret guitar is from E2 to D6 (82 to 1174 Hz) w/overtones extending higher
* All of these frequencies may not be amplified b/c guitar chords attenuates frequencies about 5 kHz

MIKING THE GUITAR AMP

* Small practice type am/speaker system
* High-quality amps helps guitars high end by incorporating sharp rise in response range at 4 to 5 kHz – helps give it a clean, open sound
* Cardioid dynamic is the most popular mic used to pick up an electric guitar amp
* Dynamic mics give the sound a full bodied sound without extra amp’d noises
* Guitars mics have presence peak in upper frequency range – adding clarity
* For increased separation…
  + Mic can be placed at working distance of 2 inches to 1 ft
* When miking at a distance of less than 4 inches – mic/spkr placement is critical
* For a brighter sound…
  + Mic should face directly into the speakers cone
    - Placing it off cones center produces a mellow sound while reducing amplified noise
* Isolation cabinets…
  + Used to reduce leakage
  + Provide greater control over instruments levels w/I recording studio or control room

RECORDING DIRECT

* DI box often used to feed output signal of electric guitar into mic input of console
  + A cleaner more present sound will be recorded
  + Reduces leakage that results from having guitar amp in studio
  + Can be assigned to one or multiple tracks
* During overdub – ambient image can be opened up…
  + Mix a semi distant and distance mic with the direct mic
    - Can be mixed into stereo field or rear of surround field

THE ELECTRIC BASS GUITAR

* Fundamentals of electric bass range from E1 to F4 (42.3 to 343.2 Hz)
* Playing loudly with a pick adds harmonic range up to 4kHz
* Playing slap style or with pick gives a brighter, harder attack
* Finger style produces more mellow tone
* Recorded direct for cleanest possible sound
* Can be miked at amplifier or through DI box
* If amp is miked…
  + Dynamic mic usually choose for deep rugged tones
  + When combined with a boosted response of 100 Hz – large diaphragm dynamics give a warm, mellow tone that adds power to lower register
* Equalizing the bass sometimes increase clarity
* Compressor commonly used on electric and acoustic basses
* Fast attack (8-20 millisec)
* Slower release (1/4 to ½ sec)
  + All 3 help to create a strong presence in the bassline

**KEYBOARD INSTRUMENTS**

GRAND PIANO

* Can be miked different ways depending on artist/producer/engineer
* Overall sound comes from pianos strings, soundboard and mechanical hammer system
* A minimum distance of 4-6 ft is need to capture full tonal balance
* Pianos miked at a distance that favours different parts of the instrument
  + Strings / Soundboard
    - Holds a bright relatively natural tone
  + Hammers
    - Holds sharp percussive tone
  + Soundboard Holes Alone
    - Holds sharp full bodied sound
* 2 basic grand painos styles can be found in a recording studio
  + Concert grand
    - Rich, full bodied tone
  + Studio grand
    - Suited more for modern music production
    - Sharper more percussive edge to tone
* Mic placement guidelines
  + Position 1
    - Mic is attached to entirely open lid
    - Most appropriate mic to use for pickup is the boundary mic
    - Can be permanently attached or taped
    - Uses lid as collective reflector
    - Provides excellent pickup under restrictive conditions
  + Position 2
    - 2 mics placed in a spaced stereo configuration at a working distance of 6 inches to 1 inch
    - One mic positioned over the low strings
    - One mic positioned over the high strings
  + Position 3
    - Single mic or coincident stereo pair is placed inside piano between soundboard and open lid
  + Position 4
    - Single mic or coincident stereo pair placed outside piano facing into open lid
  + Position 5
    - Spaced stereo pair placed outside the lid facing into the piano
  + Position 6
    - A single mic or stereo coincident pair placed just over piano hammers
    - Placed at a distance of 4 to 8 inches to give driving sound

SEPERATION

* Associated with grand pianos
* Can be achieved in the following ways
  + Place piano inside seperate isolation room
  + Place separator between piano and its louder neighbour
  + Place mics inside piano and lower onto short stick
    - Heavy blanket can be placed over lid to reduce leakage
  + Overdub instruments at a later time
    - Lid can ne remover or popped up with large stick
      * Allowing mic to be placed at a more natural sounding distance

UPRIGHT PIANO

* Designed for home enjoyment
* Mic techniques are different
* Difficult to achieve respectable tone quality
* Try the following methods…
  + Miking over top
    - Place 2 mics in a spaced fashion over an front of pianos open top
      * One over bass strings
      * One over high strings
    - If isolation isn’t a factor – open front face that covers strings
    - To reduce resonance angle piano out and away from walls
  + Miking the kick board area
    - For a more natural sound – remove kick board at lower front part of piano to expose strings
    - Place stereo spaced pair mics over strings
      * About 8 inches over bass and high strings
    - If only one mic is used – place over high strings
  + Miking the upper sound board area
    - Reduce excuessive hammering attack by…
      * Placing mic pair about 8 inches from soundboard above both bass and high strings
    - Reduce muddiness
      * Soundboard should be facing into room or moved away from walls

ELECTRONIC KEYBOARD INSTRUMENTS

* Signals from most electronic instruments inserted through DI box or directly into channel
* A good Hammond or organ can sound wonderfully dirty through miked loudspeaker
  + Windscreen may be needed

**PERCUSSION**

DRUM SET

* Provides heartbeat of basic rhythm track
* Composed of…
  + Kick drum
  + Snare dum
  + Tom rack
  + Low toms
  + Hi-hats
  + Variety of cymbals
* 1960s – 1970s
  + Drum sets were placed in isolation room called DRUM BOOTH
    - Acoustically isolated from the rest of instruments in the studio
    - More tightened drum sound
* Today engineers move drum set out of small room into larger open studio areas
  + Sound can fully develop and take on room acoustics
  + Can also be exaggerated by placing distant mic pair in room
    - Produces fuller sound
* Before session begins drummer should tune each drum will baffles and mics are being setup
* Once drums are tuned – listen to each channel for hums, buzzes, rattles or after rings
* Close miking picks up noises and desired sound
* To control extra noise, hums, buzzes or rings
  + Use duct tape or masking tape to dampen them
  + Place a cloth to dampen rings
  + Paper towel or wallet can be taped to the head
* During recording, you should remove all damping mechanisms to get the natural sound of the drums
* Removing front head and placing blanket inside drum dampens kick drum
* Kick drums usually recorded with front heads removed

MIKING THE DRUM SET

* Treat each grouping as their own instrument
* Best place to start when miking drum set is to start with fundamental groups
  + Place mic on kick
  + And then on snare
* A drum kit at minimum can be pickup using 4 mics
  + Which adds 2 over head pickups either spaced or coincident
* A mics frequency response, polar pattern, proximity effect and transient response should be taken into account when matching various drums
* Dynamic range is another consideration
* Chosen mics must be able to withstand strong peaks without distorting
  + Still capturing delicate nuances of sound
* In a studio setting…
  + Usually place drum kit on riser
  + Reduces amount of low end thud that can leak through
* You may run into the following drum senarios…
  + Drums could be placed in their own room – isolated from other instruments
  + To achieve bigger sound – drums could be placed in larger studio room while other instruments are placed in the smaller studio rooms
  + To reduce leakage – drums placed in studio can be enclosed by 4-foot or higher divider flats

KICK DRUM

* Adds low energy drive or punch
* Produces low frequencies at high sound pressure levels
* Necessary to use mic that can handle and produce signals
* Best mic choice is a large-diaphragm dynamic mic
* Moving mic closer to head can add warmth and fullness
* Moving it further often emphasizes high frequency click
* Placing mic closer to beater emphasizes hard thud sound
* Off center pickup captures more of drums characteristic skin tone
* A dull loose kick sound can be tightened to produce a sharper more defined sound by…
  + Placing a blanket or other damping materials inside drum shell firmly against beater head
* Cutting back kick eq at 300 to 600 Hz can help reduce dull cardboard sound
* Boosting 2.5 to 5 kHz adds a sharper attack, click or snap

SNARE DRUM

* Snare mic aimed just inside top rim at a distance of about 1 inch
* Mic should be angled from other drum parts
* Rejection angel should be aimed at either hi-hats or rack toms
* Mics polar response is cardioid
* Bi-directional and super-cardioid offer tighter pickup angle
* Crisp, bright snare sound achieved by…
  + Placing an additional mic on snares drums bottom head
    - Then combining 2 mics onto a single track
  + Reverse bottom mics phase polarity
* Dampening rings used to reduce ring and deepen instruments tone
  + Dampen by taping billfold or similar sized folded paper towel to top of drumhead
    - Few inches off edge

OVERHEADS

* Generally used to pick up high frequency transients of cymbals with crisp accurate detail
  + Provides overall blend of entire drum kit
* Condenser mics chosen for accurate high end response
* One type of mic placement is spaced pair
  + 2 mics suspended left and right sides of kit
    - Equally distributed to pickup in a more balanced fashion

RACK-TOMS

* Can be miked individually or by placing single mic between 2 at a short distance
* When miked individually a dead sound can be achieved by placing mic close to drums top head
  + About 1 inch above and 1-2 inches from outer rim
* A more live sound can be achieved by increasing height above head to about 3 to 6 inches
* Choose hyper-cardioid pickup pattern is isolation or feedback is a consideration
* Reduce leakage and get a deep driving tone…
  + Remove toms bottom head and place mic inside 1 to 6 inches away from top head

FLOOR-TOMS

* Miked similarly to rack toms
* Mics can be placed 2 to 3 inches above top and to side of head
* Can also have the mic placed inside 1 to 6 inches from head
* Single mic can be placed above and between 2 floor toms or each can have own mic pickup

HI-HAT

* Usually produces a strong sibilant energy in high frequency range
* Keep the following 3 points in mind
  + Placing mic above top cymbal will help pick up nuances of sharp stick attack
  + Open and close motion produces rush of air
    - When miking hats edge – angel mic slightly above or below the point where cymbals meet
  + If only one mic is available
    - Snare and hi-hat can be pickup up using just the one mic
    - Place mic between the 2 facing away from tom racks as much as possible
    - Figure 8 mic can be placed between 2 with null axis facing towards cymbals and kick

**TUNED PERCUSSION INSTRUMENTS**

CONGAS AND HAND DRUMS

* Congas, tumbas, bongos are single headed, low pitched drums
  + Can be individually miked at very close distances of 1 to 3 inches above head and 2 inches from rim
  + Mics can be pulled back to a distance of 1 foot for fuller live tone
  + A single mic X /Y stereo pair can be placed about 1 foot above and between drums
* a good pickup can be achieved by placing mic at a distance of 1 to 3 feet in front drum head

XYLOPHONE, VIBRAPHONE AND MARIAMBA

* Place 2 high quality condenser or extended range dynamic pickups above playing bars at a distance appropriate to size of instrument
  + Follow 3:1 distant rule
* Coincident stereo helps eliminate possible phase errors
* Spaced pair gives a wider stereo image

**STRINGED INSTRUMENTS**

VIOLIN AND VIOLA

* Frequency range of violin is from 196 Hz to above 10kHz ; G3 to E6 (196 to 1300 Hz)
* A good flat frequency response mic should be used
* Important to use a mic thats flat around frequencies of 300 Hz, 1kHz, and 1200 Hz
* Fundamental range of viola is tuned a fifth lower than the violin
* Mic should be placed within 45 degrees of instruments front face
* Miking at a greater distance gives a mellow well rounded tone
* Closer mic positions give a scratchy more nasal quality
* Recommended mic distance for a solo instrument is between 3 and 8 inches
* Jazz / Rock styles…
  + Mic can be placed at a close working distance of 6 inches or less
* Under PA
  + Electric pickup or clipping mic can be attached to instrument.

CELLO

* Fundamental range is from C2 to C5 (56 to 520 Hz)
* Overtones up to 8 kHz
* Quality mic can be placed level with instrument and directed towards sound hole
* Chosen mic should have a flat frequency response and placed at a distance of between 6 inches and 3 feet

DOUBLE BASS

* Double bass one of orchestras lowest pitched instruments
* Fundamentals of a 4 string bass reaches down to E1 (41 Hz) and up to MIDDLE C (260 Hz)
* Overtones reach up to 7 kHz
* Mic can be aimed at the F holes at a distance of between 6 inches and 1.5 feet

**VOICE**

* The most important device in the signal chain is the vocalist
* Next concentrate on vocalist creature comforts
  + Lighting and temperature
  + Water
* Traps encountered when recording human voice
  + EXCESSIVE DYNAMIC RANGE
    - Solved by micing techniques or inserting compression into the signal path
      * Compressor automatically rides the signal gain and reduces excessively loud passages
  + SIBILIANCE
    - Occurs when sounds such as F, S, SH are overly accentuated
    - Results of tape saturation or distortion
    - Reduced by inserting a frequency selective compressor, DE-ESSER, into chain through EQ
  + EXCESSIVE BASS BOOST DUE TO PROCIMITY EFFECT
    - Reduced by increasing working distance between source and mic
    - Using omni directional mic
    - Through use of EQ

MIC TOOLS FOR THE VOICE

* Explosive popping P and B sounds results when air blasts from singers strike the mic
* Can be avoided or reduced by…
  + Placing pop filter over mic
  + Placing windscreen between mic and vocalist
  + Taping a pencil in fron of mic capsule
    - This breaks up plosive air blasts
    - Using omnidirectional mic
* Reducing problems due to leakage and isolation
  + Choice of directional pattern
  + Isolate singers with flats, barriers
  + Isolate singer in a separate iso-booth
  + Overdub vocals at a later time

**WOODWIND INSTRUMENTS**

* Flute, Clarinet, Oboe, Sax and Bassoon combine to make up the woodwind class
* Large part of the sound comes from the finger holes that span through entire instruments

CLARINET

* Commonly comes in 2 pitches
  + B clarinet
    - Lower limits of D3 (147 Hz)
  + A clarinet
    - Lower limit of C3 (139 Hz)
* Highest fundamental is around G6 (1570 Hz)
* Sound radiates mainly from finger holes at frequencies between 800 Hz and 3 kHz
* As pitch rises more sound comes from the bell
* Best mic placement
  + Aim pickup towards lower finger holes at a distance of 6 inches to 1 foot

FLUTE

* Fundamental range is from B3 to C7 (247 to 2093 Hz)
* Mic placement depends on type of music being played and room acoustics
* Mic should be placed on-axis slightly above player at a distance between 3 – 8 ft
* Modern musical styles
  + Distant ranges from 6 inches to 2 feet
  + Mic should be placed at a point 1/3 to ½ the distant from instruments mouthpiece
* Placing mic directly in front of mouthpiece will increase level
  + But breath noises will be accentuated

SAXOPHONE

* Most popular sax for rock/jazz is S-curved B-flat tenor sax
  + Findamentals range from B2-F5 (117 to 725 Hz)
* E-flat alto sax fundamental range from
  + C3 to G5 (140 to 784 Hz)
* Harmonic content rangesup to 8 kHz and can be extended to 13 kHz
* Mic should be placed roughly in the middle of the instrument at desired distance pointing slightly towards bell
* Keypad noises can be reduced by aiming mic closer to bells outter rim

HARMONICA

* Divided into 2 basic types
  + Diatonic
  + Chromatic
* Pitch determined by length, width and thickness of vibrating metal reeds
* Forming hands around instrument molds tone by forming a resonant cavity
* Tone can be deepened by opening and closing your hands