THE PURPOSE OF THE LABORATORY DESIGN GUIDELINE:

This guideline is a general overview of the design attributes that will impact the planning, design, construction and maintenance of Northwestern University's (NU) research facilities. As a living document, this guideline will evolve in the face of changing needs of NU, research, technology, methods, and people.

It is the responsibility of professional laboratory planners and design professionals to use the guideline to complement their well-developed design knowledge and experience by providing contemporary research facilities that will assist NU to effectively and successfully compete with its peer organizations for [1] the best students, faculty and staff, and [2] for available public and private research funding.

Because of the varying ages and physical conditions of the NU research facilities, there can be a wide range of laboratory configurations, installed MEP system, finishes, and fixed equipment. The following attributes are meant to be understood as being preferred and generic in nature. The specific characteristics of new or renovated space will dictate which of the following attributes are used and which may need to be replaced with more appropriate attributes.

WHAT IS A RESEARCH FACILITY AT NORTHWESTERN UNIVERSITY?

Research facilities at NU accommodate single discipline and interdisciplinary research in a sustainable manner so scientifically important and difficult questions can be investigated. Scientific research has reached a level of maturity, and has now moved beyond a gross understanding of natural phenomena, to where it is pursuing a systems approach to research.

The systems approach to research is a powerful tool that works towards successfully answering important and difficult research questions because it actively seeks to involve all relevant disciplines of study simultaneously. The synergy that is created from the interaction of the different research disciplines mutually supports and enhances the researcher's ability to collect useful information and to create new knowledge.

GENERAL CHARACTERISTICS OF RESEARCH FACILITIES AT NORTHWESTERN UNIVERISTY

Because a facility (site + building) is meant to house and support human activities, the research facilities at NU will need to accommodate the physical, social, behavioral and psychological needs of the occupants while also providing cost effective and high performance facilities. To these ends the following are desirable characteristics of NU research facilities:

1. Protects occupants from general and specialized chemical, biological, radiological and physical force hazards.
2. Provides a flexible and adaptable facility to accommodate changes in research technology, methods, staffing and pedagogy.
3. Designed to maximize usable research space to realize appropriate and necessary indirect cost recovery related to research funding.
4. Designed to effectively use resources (energy, water, materials, equipment, etc.) to establish and maintain a sustainable campus and local community environment.
5. Provides a secure exterior and interior environment to protect NU's critical assets of its people, intellectual property, and physical facilities.
6. Minimizes error due to research activities of occupants.
7. Promotes informal and formal social interactions.
8. Supports and enhances learning and creativity.
9. Acts as an effective and competitive recruiting and retention tool for the best faculty, students and staff.

LABORATORY/RESEARCH SPACE CATEGORIES

The following list describes Research Space Types as outlined in the Northwestern Research Space Master Plan. The color coding of the Research Space Types is consistent with the Planning report of the same name.

(See Section 12.0 for specific details about the below research related spaces)

ID	Space Type
1A	Office Spaces
1B	Computation
2	Testing Rooms: Human Subjects
3A	Dry Lab: Electronics
3B	Dry Lab: Small Equipment
3C	Dry Lab: Large Equipment
4	Wet Lab: Bioscience
5	Wet Lab Chemistry
6A	Optical / Microscopy
6B	Precision Measurement
7	Clean Room
8A	Vivarium
8B	Vivarium: Behavior/Testing Room
8C	Vivarium: Procedure Rooms

LABORATORY CODES AND REGULATIONS (Most Recent Editions)

The design architects and engineers shall refer to codes, regulations, or other requirements as stipulated by, but not limited to the American National Standards Institute (ANSI), National Institutes of Health (NIH), Occupational Safety and Health Administration (OSHA), National Fire Protection Association (NFPA), Centers for Disease Control (CDC), and others for the general and specific details of a particular research facility or space. The above list is not exhaustive, so it is the responsibility of the architectural and engineering designers to utilize all necessary and appropriate documents that will contribute to the planning, design, construction, and operations and maintenance of a research facility at NU. Contact the Northwestern University Office of Research Safety for further information on this matter.

GENERAL RESEARCH SPACE CHARACTERISTICS

The NU research (not teaching) labs are designed to support inter-disciplinary research. These labs are planned and designed to accommodate a number of procedures and protocols that range from gross physical studies to procedures that provide exquisite characterization of physical phenomena. These laboratories operate 365 days/year, 7 days/week, and 24 hours/day.

1.0 PLANNING

1. Confirm with the Facilities Planning Group the grossing factors to be used on public spaces circulation, offices, labs, lab support, and mechanical and utility chase spaces.
2. Basic planning module is 10'-6" to 11-0" wide; module depth will vary starting at about 24'-0" (excluding office space).
3. Minimum circulation between lab benches to be 5'-0" from edge of countertop to 6'-0" (or greater) as required.
4. Two means of egress from a lab space where possible, or as required by code.
5. Group main utility runs, and locate utilities for easy access for maintenance and operations, and to minimize disruption to research activities in lab spaces: zoned runs, interstitial floors, equipment corridors, others?
6. Office workstations: May be inside or outside of research spaces, which will impact where students can store personal possessions and drink/eat.

2.0 HEALTH & SAFETY

1. Fume Hood: Default to low-flow, double sash, 6-foot chemical fume hood with flammable and corrosive storage in the base cabinets. A vacuum cabinet may be required for fume hoods in chemistry-type labs. Please discuss and confirm with the researcher(s) and Office of Research Safety, lab utility service (e.g. power, water, specialty gases) installed in the fume hood.
2. Biosafety Cabinet: Default to Class II Type A2 unless otherwise indicated. Please discuss and confirm with the researcher(s) and Office of Research Safety, lab utility service (e.g. power, water, specialty gases) installed in the fume hood.
3. Avoid doors between lab spaces and emergency showers and eyewashes.
4. Consolidate emergency shower and other lab safety services (blanket, spill kit, etc.) together at an easily accessible area in lab.
5. Locate fume hoods and biosafety cabinets away from main lab circulation paths and entrances to lab spaces, and away from the supply air register in the ceiling system.
6. Create clear and direct interior lab circulation paths to lab entrances with no dead ends.
7. Minimize obstructions to visual sight lines into and through lab spaces where possible.
8. Minimize tripping hazards by provide space off of the lab circulation path for trash, and chemical and biohazard containers.

3.0 ARCHITECTURE

1. Entrance Door: In new construction, and where possible in renovation construction, use unequal leaf, 4'-0" wide by 8'-0" tall (where possible), with half-window in 3'-0" wide active leaf, kick plates, closer, and office hardware set with manual top/bottom, flush bolts on inactive leaf.
2. Other Doors: Single leaf, 3'-0" wide door with half-window as required, kick plates, and passage hardware set where required. In new construction, or where possible in renovation construction use a 8'-0" tall door.
3. Floor to structure height (new construction) = 15'-0"
4. Ceiling Height = 9'-6" where possible
5. Floor Live Load = 100 PSF where possible
6. Vibration Floor Deflection = 2,000 micro-inches / second
7. Interior Walls: High-impact drywall in high traffic or high abuse areas.
8. Human Factors (Ergonomics): Design to maintain and support good body posture and mechanics as a means to avoid injury during research work; avoid extensive reaching, crouching, twisting, or other exaggerated body movements. Provide knee spaces to avoid researcher from straddling chairs or stools.

4.0 FINISHES

1. Ceiling: Where used, drop ceiling w/ clear aluminum grid and moisture resistant, anti-shedding ceiling tiles with a smooth, cleanable, no-texture surface.
2. Walls: Satin paint that resists scuffing and staining, and can be cleaned (e.g. Scuff-x in high traffic areas).
3. Wall Base: Cove base; surface applied, otherwise integral with sheet material flooring.
4. Floor: Vinyl composite tile, sheet flooring or polished concrete at most locations. Confer with Facilities for flooring type to install in specialty lab spaces e.g. non-conduction flooring).

5.0 FURNISHINGS

1. Student Desks: Where possible 4'-6" wide x 30" deep with privacy panels, bookshelf above the counter and an 18" wide, lockable undercounter, mobile pedestal with a file drawer and two small drawers.
2. Lab Casework: Non-fixed metal casework with resin/epoxy, heat/chemical resistant counter tops; Use fixed casework only where necessary.
    a. Lab Bench: height adjustable with integral reagent shelves, and space undercounter for mobile or hung storage cabinets or drawer sets.
    b. Northwestern University works with "preferred vendors who supply a full range of laboratory casework, fume hoods, and plumbing and gas fixture products for use on our campuses. Contact the project manager for contact info and with any questions about the materials, construction, strength, assembly, adjustments, availability and lead times for delivery and installation of the casework.
3. Lab Shelving-Reagents:
    a. Edge barrier to prevent object falling off of shelves.
4. Chairs: desk or bench type on casters; non-fibrous upholstery; easy to clean; ergonomic controls; bench chairs with foot rest.
5. Stools: With or without casters; no fibrous upholstery; easy to clean; height adjustable.

6.0 ENGINEERING-HVAC

1. Variable air velocity HVAC system operations tied into Campus DDC system.
2. Duct Material: use 316 stainless steel ducts from fume hoods to point of connection to laboratory exhaust system.
3. Ventilation:
    a. Wet Lab: 100% single pass air.
    b. Dry Lab and Offices: recirculated where possible.
4. HVAC Sizing for Lab Equipment Heat Loads (approximate):
    a. Laboratory: 6 watts/SF
    b. Lab Support: 16 watts/SF
    c. Equipment Room: 20- 24 watts/SF
5. Lab Air Changes per Hour (ACH) = 6.2 (Aircuity 2 to 12 depending on occupancy and interior conditions).
6. Lab Space Pressurization = +/-150 CFM differential pressure, negative to adjacent spaces.
7. Temperature & Humidity (Fahrenheit & % RH):
    a. Temperature: Summer 76 F, Winter 68 F
    b. Humidity: Summer 50% Max, Winter 25% Min.
8. Fume Hood Air Flow (low flow hood) = +/- 375 CFM
9. Fume Hood Face Velocity = 82 Feet per Minute.
10. Snorkel Air Flow = 50 CFM for Nederman FX50 to 75-100 CFM for FX75 (or equivalent).
11. Gas Cylinder Cabinet (Ventilated) = +/-300 CFM for 2 cylinder cabinet, and 500 CFM for 3 cylinder cabinet.
12. Environmental Chambers: Ventilation at 0.5 CFM/SF
13. Lab Air Particle Count (0.3 to 2.5 micrometer diameter) = 500,000 to 5,000,000 PPM.
14. Toxic Gas Alarm: Threshold limit value (TLV) low level alarm; 2x TLV high level alarm; maintenance alarm to DDC.
15. Oxygen Depletion Alarm: 19.5% low level alarm; 18.5% high level alarm; maintenance alarm to DDC.

7.0 ENGINEERING-POWER & DATA

1. Clean Power: design and install electrical system and grounding to minimize unwanted signals/harmonics that will interfere with the operations of sensitive lab equipment.
2. Power:
    a. Primary Voltage: 110V/208V, 3 phase, 4 wire service.
    b. Electrical Plug Loads: 2 to 20 watts/SF range; Occupied = 5 watts/SF; Unoccupied = 2 watts/SF.
1. Power Types:
    a. Standard: Power supplied by ComEd
    b. Life Safety: Power supplied by ComEd and an emergency generator; only used for life safety systems.
    c. Standby: Power supplied by ComEd and an emergency generator; only used for Lab equipment.
    d. Uninterrupted Power Supply: supplied by the researcher in most instances.
2. Power Panel Types:
    a. Life Safety
    b. Lighting/Lab equipment
    c. Machine
    d. Note: laboratory and research facilities will utilize switchgear equipment with power-style circuit breakers.
3. Building systems and lab equipment to be on standby power (monitored/alarmed as required):
    a. Lab supply and exhaust systems (60 to 75% of full capacity) to maintain negative lab pressure, exhaust from fume hoods, and venting of fume hood base chemical storage cabinets.
    b. Environmental rooms.
    c. Ultra-low temperature freezers (for sample or archival storage).
    d. Other critical laboratory equipment and processes that cannot withstand a minimum 2-hour power loss.
4. Service Distribution: each double-module lab space to have an individual circuit breaker panel (42 breakers) rated at 225 amps.

5. Each circuit not to exceed 4 connected duplex receptacles, and alternate circuiting of adjacent outlets to minimize impact of tripped circuit.
6. Power distribution in lab by wall or casework mounted double-channel electrical/data raceways with duplex outlets located horizontally every 24".
7. Data Service: Review current NU Information Technology standards for data network materials, installation, and testing.
8. No automatic light sensors in laboratories.
9. Use stainless steel receptacle cover plates in laboratory spaces.
10. Electrical Noise and Sensitive Lab Equipment and Processes:
    a. Electrical engineer will work to prevent electrical noise from entering the power system used by lab equipment

8.0 ENGINEERING-PLUMBING & PIPING

1. Water Available: Type 3: potable water from Municipality; Type 2: reverse osmosis or deionized water supplied by each research building; Type 3: 18 Ohm by filter equipment installed by researcher; use Type 2 water for Type 3 water filter.
2. Dead Legs: avoid dead legs in reverse osmosis system, and keep to 18" or less in potable water system.
3. Specialty Gas piping
    a. Copper: medical grade, oxygen free, with braised fitting and connections.
    b. Stainless Steel: Swagelok (or similar) compression fittings where possible, but orbitally welded joints, if required.
4. Process Chilled Water (PCW):
    a. PCW is used for laboratory equipment and other processes that require continuous cooling.
    b. The PCW system is an independent, chemically treated system that is not directly connected to the lab equipment or process requiring cooling. A water-to-water heat exchanger is used between the NU PCW system and the lab equipment/process requiring cooling.
    c. When connecting to the PCW system, use a braided, stainless steel hose rated for 175 psi.
    d. 55 degrees F at 75 psi
    e. Provided to fume hoods and other locations to provide cooling to research activities and lab equipment.
    f. Potable water shall not be used to power venturi suction equipment or single pass cooling of lab equipment.
5. Tempered Water:
    a. Supplied to emergency showers and eyewashes within the allowable temperature range per applicable code.
6. House Specialty Gas Services
    a. Vacuum: 25 Torr at ¼" diameter outlet
    b. Compressed Air: dry; 110 psi main line.
    c. Nitrogen: meter required in each lab (confirm with the NU Engineering Shop); 28 to 30 psi, 99.99% pure w/ <5ppm oxygen.
    d. Helium Capture- TBD
    e. All specialty house gases shall be filtered and oil free.
7. Steam:
    a. House Steam for Autoclaves: can only be used for decontamination of biohazard materials.
    b. Local Steam Generators: Used for either decontamination of biohazard materials (not cost effective) and for sterilization of a range of materials, containers, and tools.

9.0 ENGINEERING-FIRE PROTECTION

1. Install a fire alarm pull station in lab spaces equal to or greater than 500 SF/
2. In CCM facilities only strobes can function-audible alarms and announcements are disabled.

10.0 INDOOR ENVIRONMENT QUALITY

1. Lighting:
    a. Laboratory & Offices: 30 FC ambient and 50 FC task at 36" AFF lab and 30" office.
    b. Office: 50 FC at 30" AFF
    c. Use direct/indirect lighting to reduce shadows and glare.
    d. Locate lights to reduce shadow casting.

11.0 SUSTAINABILITY

TBD

12.0 LAB SPACE SPECIFIC REQUIREMENTS

The characteristic listing under each of the below lab space types are based on Northwestern University's unique and specific requirements that may meet or exceed industry standards and best practices for research and support spaces.

ID	Requirements
1A	Office Spaces
	• Faculty are assigned private offices. • Post-docs are assigned a faculty sized space shared between two to three people. • Graduate students are assigned a space shared with two or more people, depending on the size and geometry of the space. • Offices should have access to natural light or, at a minimum, borrowed light, if landlocked; interior should be avoided. • Where possible, minimize sound transmission from entering an office space from adjacent rooms or corridors. Work towards creating a sound environment where the ambient background sound is sustained at a level of no higher than person-to-person conversation (including the activities of people and machine noise).
1B	Computation
	• Where possible, minimize sound transmission from entering the Computation space from adjacent rooms or corridors • Determine the direction, color, temperature, and controls for illumination of the space to minimize eye strain, and glare and ghosting on computer monitors.
2	Testing Rooms: Human Subjects
	• Where possible, minimize sound transmission (and vibration?) from entering the Testing Room from adjacent rooms or corridors. Confer with the researcher to determine amount of noise (and vibration?) that will not negatively impact ongoing testing and recording activities. • Confer with the researcher to determine the direction, color, temperature, and controls for illumination of the space.
3A	Dry Lab: Electronics
	Follow general lab design guidelines.
3B	Dry Lab: Small Equipment
	Similar to 3A- Dry Labs: Electronics, except as follows. • Provide earth ground to shed static charge and other unwanted electrical activity.
3C	Dry Lab: Large Equipment
4	Wet Lab: Bioscience
	Follow general lab design guidelines.
5	Wet Lab Chemistry
	Follow general lab design guidelines.
6A	Optical / Microscopy
	• Use only manual switches to control "Laser In Use" lights.
6B	Precision Measurement
	Follow general lab design guidelines.
7	Clean Room
	• Provide gas matrix diagram per Office of Research Safety
8A	Vivarium
	Characteristics to be determined
8B	Vivarium: Behavior/Testing Room
	Characteristics to be determined
8C	Vivarium: Procedure Rooms
	Characteristics to be determined