Orientation 2025-2026

GRADUATE PROGRAMS IN PHARMACEUTICAL SCIENCES Extra

Welcome

DEGREE OFFERED:

M.S.
Ph.D.
Pharm.D./Ph.D.
Participates in interdisciplinary Ph.D. program in CMB

ORIENTATION:

. The department strives to provide stipend support and tuition waiver for all graduate students.

. It is expected that you consider the pursuit of your graduate degree as being a full-time endeavor.

. It is not uncommon for laboratory work to require extended working hours and weekend work, as the situation demands.

. In many respects, you should consider yourself to be self-employed.

FACULTY ADVISOR:

Most important

The role of your advisor is to serve as your scientific mentor, to provide the resources for the accomplishment of your research projects, and to be your advocate during this process of your graduate education.

Any concerns that you are not comfortable sharing with your advisor should be taken to the department chair.

PROCEDURES:

First Year - endeavor to complete required core courses.

Graduate Student Comprehensive Examination: Once a year

To take the comprehensive exam, the student must have finished their core class work (i.e., Biochemistry 701 and 702, Applied Statistics (Stat 725), **Principles of Pharmacokinetics and Pharmacodynamics (PSCI 611) and Pharmacokinetics (PSCI 670).**

In the second year, during the third semester, each student selects an advisory committee, which consists of the thesis advisor, and three other faculty members out of which one (Graduate appointee) must be outside of the College of Health and Human Sciences.

Typically, coursework is completed in 1-1.5 years for MS candidates (**minimum 17 semester credits of letter-graded course**) and two years for Ph.D. (**minimum of 30 semester credits of letter-graded course - 18 must be at 700-level)** candidates,

leaving later years for full-time thesis research. The M.S. students must take at least 10 Cr and Ph.D. students 60 Cr, including maximum 10 credits of Research Seminar. The time to complete a graduate degree averages 2-3 years for the M.S. degree and approximately takes about 4-5 years for the Ph.D.

ADMISSION TO CANDIDACY FOR THE PH.D.:

(1). **Satisfactory performance in coursework with a min 3.0 GPA**

(2). **Satisfactory performance in Pharmaceutical Sciences Comprehensive Examination (NIH R21) format.**

(3). **Satisfactory defense of an original research proposal on a topic selected by the candidate and approved by candidate's Ph.D. advisory committee. The research proposal should be prepared in the NIH RO1 grants application format (http://www.nih.gov). The proposal should be approximately 15 pages including an abstract. The proposal should be submitted to Advisory Committee two weeks prior to scheduled examination.**

Following completion of dissertation research, the candidate must complete a written dissertation and an oral presentation to the department and advisory committee. **The written dissertation should be submitted to Advisory Committee two weeks prior to scheduled oral presentation. It is expected that the candidate will publish his/her results in peer-reviewed journals.**

The M.S. candidates are not required admission to candidacy.

COURSES OFFERED:

410/610: Pharmaceutical Biotechnology
413/613: Endocrine/Respiratory/GI Pharmacodynamics
414/614: Cardiovascular Pharmacodynamics
415/615: Neuropsychiatry Pharmacodynamics
417/617: Pharmacogenomics
470/670: Pharmacokinetics

701: Quantitative drug design
703: Drug metabolism
718: Techniques in pharmaceutical research
746: Neuropharmacology
747: Cardiovascular pharmacology
762: Advanced biopharmaceutics
767: Biomedical Grant Writing
790: Graduate seminar
793: Individual study/Tutorials
696/796: Special topics
798: Master's thesis
899: Doctoral dissertation

The department requires the following core courses for M.S. Ph.D. and Pharm.D./Ph.D. candidates:

611: Principles of Pharmacokinetics and Pharmacodynamics
670: Pharmacokinetics
790: Graduate seminar
Bioc 701 Comprehensive Biochemistry I
Bioc 702 Comprehensive Biochemistry II
Stat 725 Applied Statistics

Change from Ph.D. to M.S.

- Discouraged
- Only considered if the performance of the candidate in Ph.D. is not satisfactory

ATTENTION:

https://www.ndsu.edu/fileadmin/policy/158.pdf

Chatting or Luring Minors on the Internet is a CRIME.

Acceptable Use of Electronic Communication Devices at NDSU:

- Nominal Cost
- Does not create impropriety
- Minimal use of software
- Does not interfere with work

Unacceptable:

- Harassment
- Sex materials
- Violation of copyright
- Probing or hacking
- Use of pirated software
- Distributing viruses

Appropriate Use Review Committee (AURC)

Radiation and Safety Training: For use of Radiochemicals in research

Institutional Review Board (IRB) - Approval is needed to work on Human Research

Institutional Animal Care and Use Committee (IACUC): Approval is needed prior to use Animals in Research

Institutional Biosafety Committee (IBC): Approval is needed if you use cell lines and biohazards materials/tissues in Research

Avoiding and Resolving Problems, Conflicts, and Grievances

During graduate studies, problems, conflicts, and grievances involving the people you work with may arise. There can be numerous reasons for conflicts and it is important to resolve these conflicts as early as possible to maintain an enjoyable and productive work environment. Conflicts can involve your fellow graduate students, other people working with you in the lab, staff members and faculty.

General Remarks:

1. The people you work with may not be aware that you perceive a certain situation as problematic.
2. Bringing up your concerns in a friendly and constructive way may resolve the situation.
3. Your advisor should be the first person to talk to about most problems arising during your time in the department.
4. Besides your advisor, other faculty and staff members of the department can be approached for help with problems and grievances
5. The University also provides counseling resources to students and employees that can be utilized.
6. Your graduate research committee is a source of support to you. It's role is in part to help you during your studies with issues concerning your research.
7. Verbal agreements can be summarized by a follow-up email to avoid misunderstanding and future conflicts.

The following table lists some possible problems and suggests the steps you should take to resolve the problem

Problem	Steps to approach the problem
Safe, efficient and collegial work environment in shared departmental facilities	1. Bring the problem to the attention of the person in charge of the facility or instrument. 2. Let the departmental office (Administrative Assistant) know about it, and she will send out an email to the department regarding the issue.
Safe, efficient and collegial work environment in your research group	1. Talk to your advisor. He/she is in charge of all issues concerning his/her research lab.
Work hours, work expectations, vacation time	1. Inform yourself regarding typical work hours and expectation for graduate students. Graduate research is not a "nine to five" job, and sometimes

	requires additional work hours to meet deadlines or to complete an experiment. 2. Talk to your supervisor if you feel that your work hours or expectations are not reasonable or if you need special accommodations for exceptional personal circumstances. 3. Vacation time must be coordinated with and approved by your supervisor.
Direction and supervision of your graduate research	1. Talk to your supervisor with any concerns regarding research direction and progress. 2. Use the experience of your graduate advisory committee. The role of the committee members is to oversee and to support your progress in the graduate program. Committee members have extensive research experience and may have experienced difficult situations to you.
Scientific integrity and honesty	1. Your research advisor should be the first person to approach in most cases. 2. Contact the chair of the department if your advisor is not responsive to your concerns.
Expectations for candidacy exams (preliminary defense) and graduation	1. Make a plan of study together with your advisor and the members of your graduate advisory committee. 2. You may ask your advisor to document the agreed upon expectations for preliminary defense and graduation in writing.

If the steps listed in the table above do not resolve the problem or conflict, contact the chair of the department. The chair will then get involved and mediate between the conflicting parties. Depending on the circumstances, the chair will seek additional input from faculty or staff at his discretion.

Departmental Bylaws

Conflicts between a graduate student and the major research advisor that cannot be resolved or mediated with the involvement of the student's research advisory committee or the chair of the department shall be brought to the attention of the departmental faculty. The chair, after consultation with the faculty, shall appoint a panel of at least four faculty members and three students to investigate the conflict and to mediate between the conflicting parties. The panel shall make a written summary of findings and recommendation of conflict resolution within three months after initial appointment.

Pharmaceutical Sciences Graduate Student Comprehensive Exam

The process to be admitted to candidacy includes 2 exams: (1) the comprehensive exam, generally taken in the second year, and (2) the preliminary proposal defense (described in a separate document). This document describes the procedures to complete the comprehensive exam.
The comprehensive exam consists of a written research proposal following the NIH R21 grant format, and an oral examination based on the research proposal.

Each student must develop a research proposal that outside the students current and past research projects. The chosen topic must include elements of pharmacokinetics (PK) and pharmacodynamics (PD). During the oral defense, students will be tested on the principles of PK/PD relevant to their proposal.

The student initially submits a 30-line abstract on their chosen topic to the examination committee.
The committee will provide feedback on the suitability of the topic in consultation with the major advisor if needed. Once the abstract has been approved by the examination committee, the student will develop a 6-page NIH R21 style research strategy with an additional section of references. In addition to the six-page research strategy, the student will need to provide a one-page Specific Aim document, a NIH-style Biosketch, and a Vertebrate Animal section, if the student plans to use animals in the proposed study. A budget and budget justification are not required. The font of the document should be Arial, size 11 or larger with US letter page margins of 0.5 inches or more. Preliminary data is not required, but can be taken from current literature to support the underlying scientific premise of the student's proposal. After submitting their proposal to the examination committee, the students will have 2-4 weeks (depending on scheduling) to prepare an oral defense of their proposal. The student must pass both the written and oral components of the examination within two attempts.

Exam Committee
The exam committee shall be comprised of 3 PSCI faculty members, and none should have conflict with the student being examined. In the case of conflict, new member (s) will be added to the committee to avoid conflicts to serve on that particular student's examination committee.
To avoid potential conflict of interest, alternate committee members may be assigned, or multiple committees may be formed.

Eligibility
To take the comprehensive exam, the student must have finished their core class work [i.e., Bioc 701, Bioc 702, Stat 725, Pharmacokinetics (PSCI 670) and Pharmacodynamics (PSCI 611)].

Due Dates
The examination will be administered once in a year during summer and fall semesters.

June 01: Abstract must be submitted by the student to the chair of the exam committee
On or around June 30: Feedback from the committee on the suitability of the proposed research project based on the abstract
August15: Full proposal due to the chair of the exam committee by email or printed copy if requested
October 01 to Nov 30: Oral exams are scheduled at the discretion of the exam committee

Scoring
Exam committee members will provide scores as described under Scoring of Comprehensive Exam of Ph.D. Students to reflect their assessment of the candidate's ability to develop and communicate (both written and oral) their ideas of high scientific quality, in consideration of the following proposal elements:

- Written English (**ABO 2.1**)
- Experimental Design (including experimental rigor) (**ABO 1.2 and 1.6**)
- Hypothesis and Aims Development (**ABO 1.2 and 1.6**)
- Scientific Logic (including the scientific premise) (**ABO 1.2 and 1.6**)
- Alternative Approaches (**ABO 1.2 and 1.6**)
- Use of pharmacokinetics/pharmacodynamics (**ABO 1.1**)

Exam committee members will use a 5-point rating scale (as shown under Scoring of Comprehensive Exam of Ph.D. Students).

Specific Ability-Based Outcomes (**ABOs**) to be Assessed
1.1 The student has a well-rounded scientific knowledge relevant to pharmaceutical sciences
1.2 The student is able to develop and plan a scientific experiment
1.6 The student is able to develop an experimental strategy to test a scientific hypothesis
2.1 The student is able to write a scientific abstract, poster or short communication **(Abstract submission)**
2.3 The student is able to write a research grant proposal **(Proposal)**
2.4 The student is able to prepare and deliver an oral research presentation **(Oral defense)**

Cheating and Plagiarism
During the development of the research idea and the written proposal elements, students should not discuss their ideas with faculty, post-docs or other individuals that hold a PhD in a STEM field. Any external input into the student work will be viewed as academic misconduct and the examination will be scored as failed. Following approval of the student's abstract by the exam committee, in no circumstances should the students seek advice from their current advisor, or send the proposal to their advisor and ask for edits/clarity/improvement. In addition, the student should NOT ask the advisor to coach the presentation of the student or review the slides prepared by the students.

Evidence of plagiarism in the proposal, including in the methods section, as defined by the Department of Pharmaceutical Sciences and NDSU policy

(https://www.ndsu.edu/academichonesty/) will also void the examination and will be addressed according to departmental and college policies.

Generally speaking, students are not authorized to use artificial intelligence engines or software (or similar) to produce work for the comprehensive exam. Use of artificial intelligence may be subject to failure on the exam and/or academic misconduct sanctions according to NDSU's academic integrity policy (Policy 335). If students have any question about which tools or uses of those tools are appropriate, they should contact the chair of their comprehensive exam committee by email as soon as possible.

Scoring of Comprehensive Exam of Ph.D. Students

The scoring system will use a 5-point rating scale on each of the following criteria. Please calculate the average of the scores given and enter it into designated box.

Score (points) / **Aspects**	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)	
Written English (5 points)						
Experimental Design (5 points)						
Hypothesis and Aims (5 points)						
Scientific Rigor (5 points)						
Alternative Approaches (5 points)						
Use of Pharmacokinetics and/or pharmacodynamics (5 points)						
Total points 30						

Total Maximum Point: 30

Pass 21 and above

Conditional average 20-15 (Needs to re-submit the proposal addressing all critiques)

Fail 14 and below

Written Comments

1. **Written English**

2. **Experimental Design:**

3. **Hypothesis and Aims**

4. **Scientific Rigor**

5. **Alternative Approaches:**

6. **Use of Pharmacokinetics and/or pharmacodynamics:**

Written Proposal	☐	Pass	☐	Conditional Pass	☐ Fail
Oral Proposal	☐	Pass	☐	Fail	

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Revised and approved by the Department: 12/17/2024

NIH_R21_Example_1
2_17_2024_Research

This is the link to the example research paper.

SPECIFIC AIMS

The virally-mediated disease known as COVID-19 has infected and killed millions worldwide. COVID-19, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is characterized by the loss of taste, smell and chemesthesis sometimes in the absence of other common symptoms such as respiratory distress, fatigue, cough, and fever. Taste deficits are prevalent and appear to be independent from anosmia. However, the biological basis of taste loss is largely unknown, including the potential for SARS-CoV-2 infection and ensuing inflammation in taste receptor cells and ascending neural pathways. A fundamental question is whether central and peripheral taste structures are targets of SARS-Cov-2. Insight to host viral entry pathways and their normal function in taste buds is needed before SARS-Cov-2 induced taste deficits can be treated. While most patients regain taste sensation after several weeks, hypoguesia is longer lasting in a subset of patients leading to prolonged negative effects on nutrition and quality of life.

The angiotensin-converting enzyme (ACE) 2 receptor is a negative regulator of the renin-angiotensin system (RAS) that mediates fluid balance and blood pressure. RAS hormones angiotensin II and aldosterone also modulate taste function, behavior, and immune responses to taste nerve injury. A member of the RAS, ACE2, binds the SARS-CoV-2 spike protein. Prior to host cell entry the spike protein must be cleaved by proteolytic enzymes such as furin, cathepsins, and most prominently, TMPRSS2. ACE2 is downregulated as receptor bound virus is internalized by host cells, driving the RAS to proinflammatory, vasoconstrictive, and fibrotic actions that contribute to organ damage. Thus ACE2 is essential for SARS-CoV-2 infection but also mediates protective responses through the RAS. *Our preliminary results demonstrate robust ACE2 and TMPRSS2 expression in anterior and posterior mouse taste buds.*

Mouse models were highly useful in understanding the related SARS-CoV tropism and pathogenesis responsible for the severe acute respiratory syndrome (SARS) epidemic of 2002-2004. Yet the murine ACE2 receptor binds SARS-CoV-2 ineffectively compared to human ACE2. This R21 Exploratory/Developmental Research application addresses the urgent need to understand the role of ACE2 in the taste system using suitable animal models. *We have developed novel genetic mouse strains to address this gap in knowledge.* We hypothesize that ACE2 is expressed in multiple taste cell types, modulates taste nerve responsivity, and has an anti-inflammatory, protective influence on the peripheral taste system. We also test whether ACE2 bound to SARS-CoV-2 spike protein has detrimental effects on taste receptor cells and taste function which may contribute to taste deficits in COVID-19 patients. We test these hypotheses in two aims:

Aim 1. Identify ACE2-expressing cells in peripheral and central taste pathways as potential targets of SARS-CoV-2. We will map ACE2 expression using standard cell markers in a novel *Ace2-P2A-CreERT2* knock-in *($Ace2^{CE}$)* strain of mice which express inducible CreERT2 at the endogenous *Ace2* locus combined with Rosa26-tdTomato reporter mice. We will use this strain combined with antibodies to identify ACE2+ taste cell types, neurons, glia and blood vessels.

Aim 2. Determine the contribution of lingual ACE2 to taste function and taste receptor cell dynamics in the healthy and inflamed peripheral taste system and potential modulation by SARS-CoV-2 spike protein.

a. We will record responses to taste and tactile stimuli from a primary taste afferent nerve, the chorda tympani (CT), and quantify taste receptor cell number and turnover in lingual epithelium-specific *Ace2* knockout mice using a new floxed *Ace2* strain. Conditional *Ace2* knockout and control mice will also be treated with systemic lipopolysaccharide (LPS) to test taste function during lingual inflammation.

b. We will record neural responses and measure taste cell dynamics in humanized *Ace2* knock in mice (*hAce2-KI)* which recapitulate endogenous ACE2 expression. Mice will be challenged with LPS and/or a human SARS-CoV-2 spike-Fc fusion protein to determine the impact on taste function.

We expect taste changes in the absence of ACE2 reflecting the dysregulation of the RAS. Inflammation (Aim 2a) and/or downregulation of ACE2 by spike-Fc (Aim 2b) are expected to exacerbate taste alterations based on a similar approach in a mouse lung injury model.

These studies address the compelling need to understand ACE2 function in the taste system. If taste buds and associated pathways are indeed potential SARS-CoV-2 targets, we will test the effects of pseudovirus typed with human SARS-CoV-2 spike protein on taste function and behavior in *hACE2-KI* mice in future studies.

RESEARCH STRATEGY

1. Significance

The ongoing global pandemic caused by the novel coronavirus SARS-CoV-2 has resulted in millions of infections and deaths. Smell and taste deficits are major neurological symptoms of COVID-19 occurring in up to 80% of those infected often in the absence of respiratory ailments and fever[1-9]. Chemosensory symptoms are highly predictive of SARS-CoV-2 infection and hospitalizations[10-12]. Chemesthesis, mediated by sensory neurons in the lingual epithelium, also contributes to flavor perception. Recent reports indicate that loss of taste and chemesthesis can occur independently from anosmia[2,3,6]. This is consistent with prior studies demonstrating taste deficits after upper respiratory viral infection and inflammation[13-15]. Most patients regain taste sensation after recovery from viral infection but taste deficits persist in some people[16-19]. Taste is important for nutrition and quality of life lending urgency to the search for mechanisms responsible for hypoguesia in COVID-19 patients[20-25]. ***There is currently little known about the SARS-CoV-2 infection and associated inflammation in the taste system.*** *This R21 application responds to the Notice of Special Interest (NOT-DC-20-008) from NIDCD focused on "the molecular mechanisms underlying chemosensory dysfunction due to SARS-CoV-2 infection".*

Angiotensin-converting enzyme (ACE)2 in the renin-angiotensin system (RAS) and SARS-CoV-2 infection. [26]Coronaviruses are composed of a sphere of structural proteins coated with a "corona" of viral spike protein[27]. The receptor for the SARS-CoV-2 spike protein is ACE2[28,29], a negative regulator of the renin-angiotensin-system (RAS) which controls extracellular fluid volume and blood pressure[30]. In one wing of the RAS, ACE converts Ang I to Ang II which binds the AT1 receptor leading to vascular constriction, fibrosis, oxidative stress, and inflammation (Fig. 1). ACE2 counteracts these effects by converting Ang II to Ang (1-7) inducing vascular dilation, anti-fibrosis and anti-inflammatory effects[30,31]. Thus ACE2 is protective in the context of the RAS. Conversely, ACE2 enables SARS-CoV-2 infection, and the widespread expression of ACE2 throughout tissues is thought to underlie multi-organ damage in patients with severe COVID-19[31,32]. Proteases are also needed to activate the ACE2-spike protein enabling viral fusion to the host cell membrane and internalization[28,29] (Fig. 1). Host transmembrane protease, serine 2 (TMPRSS2) appears to be the most prominent spike activating protease though cathepsins[28], furin[33], and neuropilin-1 (NRP-1) are also co-factors[34]. In Aim 1 we map endogenous *Ace2* expression in the taste system of *Ace2*^{CE} reporter mice to identify potential SARS-CoV-2 infection sites underlying taste deficits.

RAS modulation of taste and inflammation. In the classic RAS feedback loop Ang II stimulates the adrenal cortex to produce aldosterone which causes Na^+ reabsorption via epithelial Na^+ channels (ENaCs)[35]. ENaC also transduces Na^+ in taste buds[36-39]. Acute aldosterone treatment increases ENaC expression[40] and function[40] in taste receptor cells and elevates amiloride-sensitive CT responses to Na^+[41]. Chronic aldosterone treatment in combination with contralateral CT nerve injury[42] or with Na^+ in drinking water[43] inhibited CT responses to Na^+. Early macrophage responses to CT nerve sectioning were also reduced by aldosterone in contrast to the hormone's well-established proinflammatory role in chronic cardiovascular injury[44]. The tissue microenvironment, injury model, and length of aldosterone treatment may account for different effects on salt taste responsivity and inflammation[44-46]. Ang II, upstream from aldosterone, suppressed amiloride-sensitive CT responses to Na^+ but enhanced sweet responses. The authors suggest that Ang II increases Na^+ ingestion by rapidly decreasing neural Na^+ sensitivity before aldosterone restores homeostasis by elevating amiloride-sensitive Na^+ responses[47]. The Ang II receptor, AT1, is co-expressed with αENaC or the sweet taste receptor subunit, T1r3, in taste receptor cells demonstrating another role of RAS in the peripheral taste system[47]. ACE2's role in taste cell function is unknown[48]. ***We will gain insight to the contribution of ACE2 to peripheral taste function under baseline and inflammatory conditions using lingual epithelial-specific Ace2 (LE-Ace2) knockout mice.***

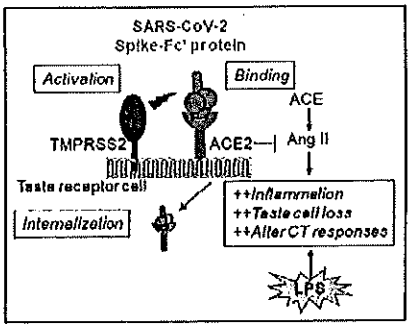

Fig. 1 ACE2 in the peripheral taste system. We propose hat taste cells express ACE2 (Aim 1) as a substrate for SARS-CoV-2 spike protein binding and entry. In Aim 2a we test whether taste nerve responses and taste cell dynamics are altered in the absence of lingual epithelium-specific *Ace2*, a negative regulator of Angiotensin (Ang) II, which drives the renin-angiotensin system (RAS) to a destructive phenotype in lung. We will test taste function in humanized *Ace2* mice in Aim 2b. Lipopolysaccharide (LPS) induced inflammation and SARS-CoV-2 spike-Fc protein are expected to further worsen taste outcomes.

ACE2 and lung injury. ACE2 is protective in mouse models of severe lung injury induced by LPS, sepsis and acid aspiration[49-53]. ACE2 knockout worsened lung function in injury models while exogenous ACE2 acting via

the AT2 receptor protects against lung damage[50]. Mice with acid-induced lung injury were given systemic SARS-CoV spike protein to establish a model that mimics SARS-CoV infection[52]. This model was critical in demonstrating viral tropism and pathogenesis in the lung[49,51,52]. The major limitation in following the same blueprint for the current pandemic is the ineffective binding of SARS-CoV-2 to the murine ACE2 receptor. *We have addressed this problem by generating novel mouse models including humanized Ace2 knock in mice (hAce2-KI) which recapitulate endogenous Ace2 expression.* In an approach used in lung, in Aim 2b we will determine taste effects of delivering a chimeric human spike protein to humanized ACE2 mice in combination with systemic LPS, which stimulates inflammation and alters taste cell dynamics and taste responses[54,55].

Expression of ACE2 and associated SARS-CoV-2 entry molecules in taste buds. ACE2 expression in the human tongue and oral cavity has been reported[56-60] most recently in type II taste cells bearing GPCRs for sweet, bitter and umami stimuli and near taste buds in post-mortem circumvallate papillae and fungiform biopsies[61]. In the latter study, replicating SARS-CoV-2 was detected in type II taste cells in fungiform papillae and taste stem cell proliferation was decreased by viral infection in patient biopsies. This study, while small, suggests that direct infection of type II taste cells could explain deficits in sweet, bitter and umami taste stimuli while indirect mechanisms could impact salt and sour taste perception[61]. ACE2, TMPRSS2 and furin expression in human taste cell cultures have also been reported[56].

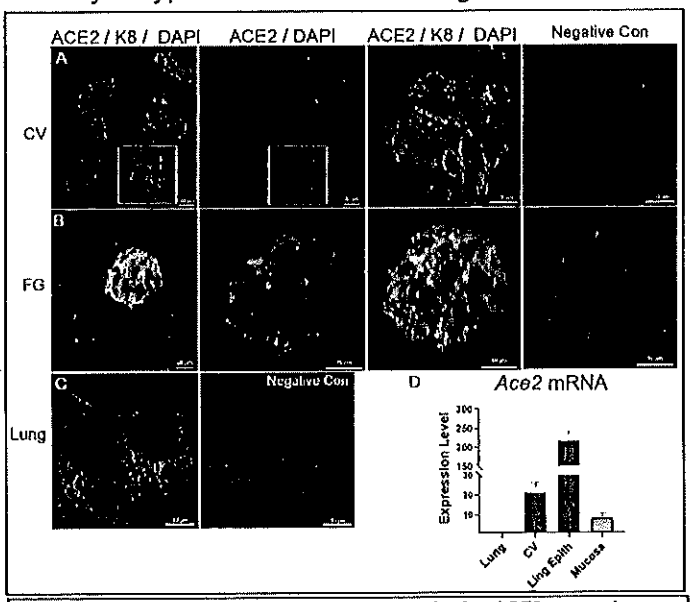

Fig. 2 Robust ACE2 expression in mouse taste buds. ACE2 expression (green) in (A) circumvallate (CV) and (B) fungiform (FG) taste buds labeled with the taste cell marker keratin (K)8 (red). CV taste buds in white squares are shown at higher magnification on the right. ACE2 antibody was omitted in negative control sections and laser settings matched to within-assay positive tissues. (C) Lung positive tissue control and nega ive staining control. Results are representative of n=3-4 mice in assays performed ≥3x. (D) *Ace2* mRNA expression in CV papillae, anterior lingual epithelium containing fungiform taste buds and lingual mucosa. Transcript levels are expressed relative to lung which was set as 1 (n=3 mice/tissue).

Whether rodent taste buds express ACE2 is currently less clear. *Ace2* was only detected in a small subset of mouse type III taste cells and lingual epithelial cells using RNA-Seq[62]. Preliminary data mining from public databases indicated more widespread *Ace2* expression in subsets of mouse type II, III and LGR-5+ taste stem cells[63]. A type I cell database was not available[63]. Though a minor part of the publication, *Ace2* was also demonstrated in mouse taste buds and non-taste epithelium[64]. ACE2 and TMPRSS immunoreactivity was reported in rat taste buds though not localized to specific types[65]. Tmprss2 was not detected in type II or III taste cells in other analyses[63].

Preliminary results. We demonstrate robust immunoreactivity for ACE2 (Fig. 2) and TMPRSS2 (Fig. 3) in K8+ taste cells from C57BL/6J mice. ACE2 and TMPRSS2 staining largely overlaps with K8, expressed by mature taste cells[66], indicating widespread expression in anterior and posterior lingual taste buds. We verified our results using lung as a positive control for ACE2 (Fig. 2C) and TMPRSS2 (Fig. 3C)[67,68]. Minimal staining was observed in negative control sections in which primary antibody was omitted (Fig. 2 and 3). Compared to lung, *Ace2* mRNA expression levels are elevated in the CV papillae and anterior lingual epithelium containing fungiform taste buds (Fig. 2D). *Tmprss2* expression levels are similar in lung, CV and anterior lingual epithelium (Fig. 3D). The reason for the difference between preliminary results and RNA-seq studies[62,63] is unclear. In Aim 1 we resolve this discrepancy with a new reporter mouse to identify even weakly-positive and transiently-expressing *Ace2*+ cells.

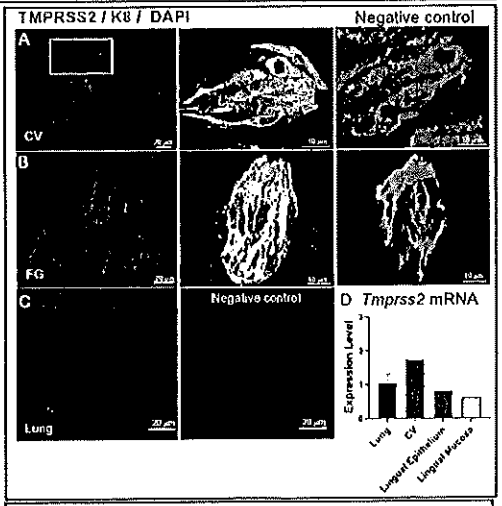

Fig. 3 TMPRSS2 expression in mouse taste buds. TMPRSS2 is expressed in K8+ taste buds in (A) CV and (B) FG papilla andTMPRSS2-omitted negative control. Positive and negative staining is also shown in (C) lung. Results are representative of n=3-4 mice in assays performed 3x. (E) *Tmprss2* mRNA expression levels in the CV and anterior lingual epithelium were similar to those in lung which was set as 1 (n=3 mice / tissue).

To facilitate the identification of *Ace2*-expressing cells and the functional study of ACE2 in the taste tissue, we have been creating in the C57BL/6J background the following three novel *Ace2* mouse models

(Fig. 4 and Table 1): (1) *Ace2-P2A-CreERT2* (*Ace2*^{CE}) knock-in mice: a tamoxifen-inducible CreERT2 (CE) fusion protein is inserted in-frame to the C-terminus of endogenous ACE2, an approach that we have recently used to create *Gfi1*^{GCE} mice[69].

The self-cleaving P2A peptide allows the co-expression of CE from the endogenous *Ace2* locus without disrupting ACE2 expression and function. In Aim 1, we will use this *Ace2*^{CE} strain to activate reporter gene expression in *Ace2*-expressing cells and determine the taste cell types and primary taste structures potentially targeted by SARS-CoV-2. (2) *Ace2* conditional knockout (*Ace2*^{loxP}) mice: Exon 4 is floxed by loxP and can be deleted by Cre recombinase to cause a shift in reading-frame and the inactivation of *Ace2*. This strain allows study of *Ace2* function in tissue/cell type-specific fashion; and (3) Humanized *Ace2* knock-in (h*Ace2*-KI) mice: Human *Ace2* and SV40 polyadenylation sequences are knocked in the first *Ace2* coding exon (exon 2) and in-frame with the translation initiation Met codon at mouse *Ace2* locus. Thus, hACE2 expression is driven by the mouse endogenous *Ace2* promoter and should recapitulate the expression of endogenous ACE2. *Ace2*^{loxP} and *hAce2*-KI mice will be used for neurophysiological studies in Aim 2. Currently, we have successfully generated germline-transmitted h*Ace2*-KI and *Ace2*^{loxP} mice as well as *Ace2*^{CE} (see PCR genotyping confirmation of heterozygous mice in Fig. 4) and expect to obtain *Ace2*^{CE} germline transmitted heterozygous mice by September, 2021.

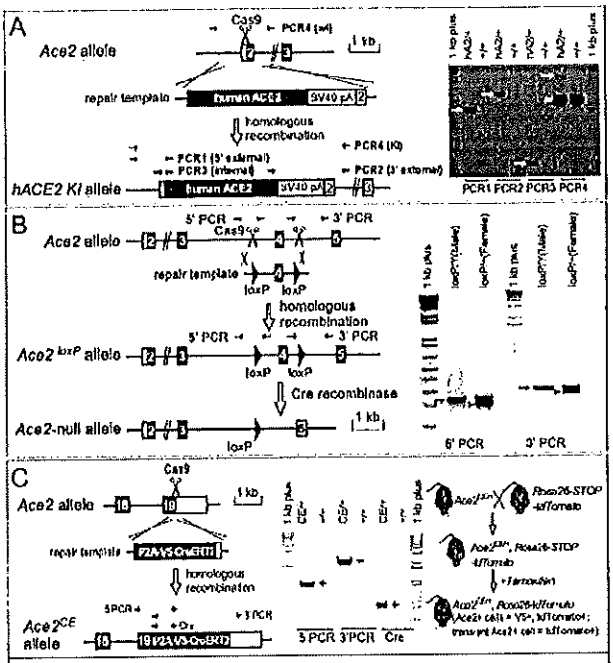

Fig. 4 Generation of novel *Ace2* mice. (A) *hAce2-KI* targeting strategy and PCR genotyping confirmation of *hAce2-KI* heterozygotes. (B) *Ace2*^{loxP} targeting strategy and PCR genotyping confirmation of *Ace2*^{loxP} mice. (C) *Ace2*^{CE} targeting strategy and lineage tracing of *Ace2*-expressing cells by tamoxifen-inducible CE and Rosa26-tdTomato reporter gene. Arrowheads and arrows indicate WT and targeted *Ace2* PCR fragments, respectively.

Table 1: Novel mouse strains used in proposal

Strain	Description	Use
Ace2-P2A-CreERT2 knock-in (*Ace2*^{CE})	Expresses CreERT2 at the endogenous *Ace2* locus combined with the tdTomato from Al14 Rosa26-STOP-tdTomato reporter mouse line	Aim 1: Map *Ace2* expression in the peripheral and central taste system
Ace2 conditional knockout mice (*Ace2*^{loxP})	Bred to K14-cre mice (JAX #018964) to generate taste receptor cell and lingual epithelium-specific knockout strain *LE-Ace2 KO*	Aim 2a: Role of LE-*Ace2* in taste function, dynamics, and response to LPS challenge
Humanized *Ace2* knock-in mice (*hAce2-KI*)	Expresses he human *Ace2* gene under the control of the endogeous *Ace2* regulatory sequence	Aim 2b: Test taste func ion, dynamics, and response to human spike-Fc protein +/- LPS-induced taste inflamma ion

Scientific premise. ACE2 expression in taste buds is supported by our preliminary results, recent studies using human samples[56-61], and some[64,65] (or partially in agreement with[63]) but not all[62] reports using rodent samples. Experiments proposed in Aim 1 using the novel *Ace2*^{CE} mouse strain will resolve inconsistencies. The premise that SARS-CoV-2 causes taste loss is widely accepted driving the need for biological insight to underlying mechanisms[2,63,70]. Strong evidence confirms SARS-CoV-2 entry mechanisms through ACE2 and TMPRSS similar to SARS-CoV[28,71]. Additional proteases activate SARS-CoV-2 in other systems[72,73], though which mechanisms prevail in taste buds is unknown[63]. Previous studies demonstrate the role of ACE2 in SARS-CoV pathogenesis in the lung[49-51,53]. This work provides a guide for developing a clinically-relevant mouse model to test taste changes caused by the human SARS-CoV-2 spike protein.. The involvement of the RAS in taste buds is also supported by evidence from multiple laboratories over time[40-43,47]. Whether ACE2 counteracts Ang II to modulate taste function and inflammatory responses is unknown (Fig. 1), leading to a major gap in our understanding of this fundamental homeostatic system addressed in the proposed studies.

2. Innovation

The rapid emergence and spread of SARS-CoV-2 created a lag between the recognition of taste deficits in COVID-19 patients and insight to biological underpinnings. Major limitations in discovering mechanisms underlying taste loss have included limited mouse models due to ineffective binding between the SARS-CoV-2 spike protein and mouse ACE2[74], the lack of BSL3 facilities needed to work with the virus, and the shortage of investigators trained in both chemosensation and immunology. ***We resolve each limitation in this R21 Exploratory /Developmental application:*** (1) Dr. Gan used CRISPR/Cas9 to develop new mouse models including a humanized *hAce2-KI* strain (Table 1); (2) human spike-Fc protein will be used in *hAce2-KI* mice to define inflammatory responses and taste loss in standard labs; and (3) Dr. McCluskey trained in prominent

taste and neuroimmunology laboratories and has studied the taste-immune axis independently for >20 years. ACE2 in our humanized mice is expressed at the endogenous locus and is physiologically relevant. The use of the K18 promoter to drive ACE2[75,76] expression in commercially-available mice is of particular concern since a subset of rodent[66,77,78] and human[79] taste receptor cells express K18. One *hAce2*-KI strain, newly available from Jackson Laboratory[80], is available if needed for Aim 2b (Alternative outcomes). We have encountered unexpected hair cell and taste bud regeneration phenotypes in transgenic strains highlighting the need for multiple *Ace2* mouse models. Together the novel mouse models and combined expertise of the team will enable fundamental insights to ACE2 and spike protein function in the taste system.

3. Approach.

In Aim 1 we map ACE2 expression in the taste system using novel *Ace2*^{CE} and Rosa26-tdTomato reporter mice. In Aim 2 we use the conditional *LE-Ace2 KO* and *hAce2-KI* to test the role of ACE2 in taste function, inflammation, and in response to human SARS-CoV-2 spike protein.

Scientific rigor, reproducibility, and sex as a biological variable. We determined group sizes by power analyses and chose statistical analyses in collaboration with Dr. Daniel Linder in the Dept. of Biostatistics & Epidemiology at the Medical College of Georgia. Analyses will be performed by personnel blinded to sample identity and treatment when possible. Each experiment will be and include multiple treatment groups. We will test both male and female mice and analyze gender as a variable since SARS-CoV-2 affects men and women differently. Men with COVID-10 die at a greater rate than female patients but it is currently unclear whether disparities in ACE2 expression, innate and acquired immunity or other factors are to blame[81-87]. In contrast, chemosensory deficits appear to be more prevalent in SARS-CoV-2 positive females vs. males[4,88]. Young adult mice (8-10 weeks old) will be used in the proposed studies since determining the role of ACE2 in taste across the lifespan is outside the scope of this 2-year project.

Aim 1. Identify *Ace2* expressing cells in peripheral and central taste pathways as potential targets of SARS-CoV-2.

Rationale In this aim, we will generate *Ace2*^{CE} tamoxifen-inducible CreERT2 knock-in mouse strain by crossing *Ace2*^{CE} founders with wild type C57BL/6J mice. We will then cross *Ace2*$^{CE/+}$ mice with conditional tdTomato reporter mice (Ai14 Rosa26-STOP-tdTomato, JAX #007908) to generate double heterozygous *Ace2*$^{CE/+}$, Rosa26-STOP-tdTomato mice. The expression of tdTomato in the *Ace2*-expressing cells will be activated by i.p. injection of tamoxifen (1-5 consecutive daily dosage of 40 µg/g body weight) into adult *Ace2*$^{CE/+}$, Rosa26-STOP-tdTomato mice. The high tdTomato expression level from Rosa26-CAG promoter allows easy detection of *Ace2*-expressing cells. We will co-immunolabel tdTomato and standard taste cell, neuronal, glial and vascular markers to determine endogenous *Ace2* expression in peripheral and central taste pathways listed with abbreviations in Fig. 5: (1) Anterior, posterior and palatal taste buds; (2) Sensory afferent fibers from the CT (anterior), GL (posterior), GSP (palate) and lingual nerves (lingual epithelium); and (3) taste structures from taste ganglia through GC. We will also map SARS-CoV-2 protease activators which promote viral entry to host cells (Fig. 3). Together, these results will indicate potential mechanisms for SARS-CoV-2 induced taste deficits due to the loss of: (1) type I glial-like taste cells; (2) type II sweet, umami, and bitter-sensing cells; and (3) type III sour and salt-sensing cells which also synapse with afferent nerve fibers[89]. Infection of each taste cell population could affect taste qualities directly or through inflammatory bystander effects on intact taste cells. *Ace2* expression in taste stem and progenitor cells suggests that taste cell replacement may also be dysregulated by viral infection[61,63]. *Together results from this aim provide insight to potential targets of SARS-CoV-2 in murine taste buds and central taste regions.*

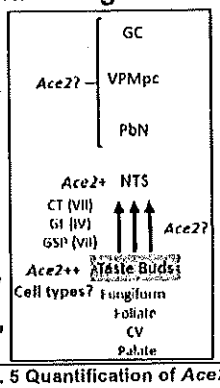

Fig. 5 Quantification of *Ace2* expression in taste structures. *Abbreviations*: circumvallate (CV); greater superficial petrosal nerve (GSP); glossopharyngeal nerve (GL); chorda tympani nerve (CT); nucleus of the solitary tract (NTS); parabrachial nucleus (PbN); medial parvicellular region of the ventral posterior medial thalamus (VPMpc); gustatory cortex (GC).

Expected outcomes. We hypothesize that: (1) *Ace2* and TMPRSS2 are expressed in type I, II, and III taste cells based on preliminary results (Fig. 2, 3); (2) stem cells in anterior and posterior taste buds express *Ace2* and TMPRSS2[61,63] and (3) taste afferent nerves and their cell bodies are *Ace2* negative based on preliminary transcriptional profiling[63]. ACE2 expression in the NTS is established[90-92] but only preliminary in the PbN to date[93]. To our knowledge endogenous vs. K18-driven[76,94,95] *Ace2* expression has not been determined in the mouse VPMpc or specifically in GC[96-98]. Thus we will confirm Ace2 in the rostral NTS and determine its expression in taste projection areas because their potential for SARS-CoV-2 infection is currently

unresolved[76,86,94,95,99-102]. PbN is not a major taste projection area in humans[103] but its inclusion provides insight to potential RAS regulation of taste and cardiovascular function[90,91,104]. Subsets of endothelial and/or glial cells may express *Ace2*+ though this remains contested and likely varies across brain regions[105,106].

By colabeling with anti-V5 antibody, we can also determine cells that are expressing *Ace2* presently (V5+ and tdTomato) or transiently (V5- and TdTomato+) in taste buds. Furthermore, the highly sensitive cell lineage tracing approach allows the identification of cells with transient and/or weak ACE2 expression, which may not be detected by immunolabeling with ACE2 antibody. These novel ACE2-expressing cells will be the focus of future neurophysiological and behavioral studies using pseudotyped virus.

Immunofluorescence and qPCR. Tamoxifen-induced *Ace2*^{CE}, Rosa26-TdTomato mice and control genotype littermates with and without tamoxifen (n=4/gender/group) will be perfused and taste tissues dissected and cryosectioned. Mouse taste buds will be co-labeled with anti-TdTomato to detect *Ace2*-expressing cells and antibodies to type I marker NTPdase2[107-109], type II marker PLCβ2[110,111], and type III marker carbonic anahydrase IV (CA4)[111-113]. If type II and III taste cells are positive we will co-localize ACE2 with markers for functional subsets (e.g. T1r1, T1r2, T1r3, OTOP-1)[89,114]. We will double label tdTomato with the stem cell markers Lgr6 in anterior taste buds[115], Lgr5 in posterior taste buds[115-117] and the taste progenitor marker K14[117,118]. CT fibers will be identified by P2X3[119-121], cell bodies with Phox2b[122,123], and GL, palatal and lingual nerve fibers with neurofilament[124,125]. TdTomato-expressing *Ace2*+ neurons in the petrosal and trigeminal ganglia and central taste regions will be identified with βIII tubulin[126]. Non-neuronal *Ace2* expression will be co-localized with specific glial[127] and vascular markers[128] since these populations may be targets of SARS-CoV-2[129,130]. Negative control sections will be incubated in normal sera followed by secondary antibodies.

Confocal images will be acquired with a Nikon A1R multiphoton/confocal system and analyzed with NIS Elements Version 4.3 (Nikon) and ImageJ (NIH). Double- and single-positive taste cells will be determined by cell counts or integrated density. Ganglia will be stained as whole mounts and double-positive and single-positive cells counted as described[122]. *Ace2*+ neurons, glia or vessels will be also be quantified in the NTS, PbN, and GC[131-133]. The PIs' department has a new automated analysis system with NeuroInfo software (Microbrightfield) which delineates brain regions on images using the Allen Mouse Brain Atlas[134]. In *Ace2*-TdTomato+ taste structures we will co-localize cell markers and SARS-CoV-2 activators TMPRSS2, furin, NRP-1, and Cathepsin B and Cathepsin L[34,63,65,73,135-137]. We will confirm *Ace2* and viral entry co-factor gene expression by qPCR in the CV, FG punches, non-taste lingual epithelium and taste neurons in C57BL/6J mice as in Fig. 2-3[138,139]. Single-positive cells, double-positive cells, and mRNA expression will be compared between groups with ANOVAs followed by Bonferroni posttests.

Alternative outcomes and potential pitfalls. Dr. Gan is an expert in CRSPR/Cas9 technology and has extensive experience using Cre-activated reporter gene expression in cell lineage analysis[69,140-143]. We do not expect problems in generating sufficient *Ace2*^{CE} mice. We have validated ACE2 and TMPRSS antibodies in CV and FG taste buds (Fig. 2-3) in case of unforeseen circumstances.

Aim 2a. Determine the contribution of lingual ACE2 to taste function and taste receptor cell dynamics in the healthy and inflamed peripheral taste system. *We will record responses to taste and tactile stimuli from the chorda tympani (CT) nerve and quantify taste receptor cell number and turnover in LE-specific Ace2 knockout mice using a new floxed Ace2 strain. Conditional Ace2 knockout and control mice will also be treated with systemic LPS to test taste function during lingual inflammation.*

Rationale. We will use conditional *Ace2* knockout mice in this aim to probe the function of the SARS-CoV-2 receptor in taste buds. Removing the ACE2 brake on Ang II exacerbates inflammatory responses to LPS and tissue injury in other tissues (Fig. 1). We hypothesize that lingual cytokine and leukocyte responses to LPS will also be elevated in conditional *LE-Ace2* KO mice dampening neural taste responses to multiple stimuli. *The unknown role of ACE2 in taste function is a barrier to understanding taste deficits caused by SARS-CoV-2.*

LPS treatment and neurophysiology. *LE-Ace2 KO* or heterogeneous littermates will receive LPS (5 mg/kg b.w.) or PBS i.p. We will record CT responses to salt (with and without 50 μm amiloride), sweet, bitter, acid, and sour tastants, 4°C water, and tactile stimulation at 6 and 24 hr after treatment according to standard methods (n=5 male and n=5 female mice/group/timepoint)[138,139,144]. The timing is based on cytokine and neutrophil responses to LPS within hours and changes in taste cell dynamics at 24 hr[54,145-149]. Terminal blood and tissues will be collected following recordings and used to measure circulating cytokine levels with multianalyte ELISAs. Cytokine levels in taste epithelium will also be analyzed by qPCR and local macrophage, T cell and neutrophil responses by immunofluorescence[138,148-151]. We will count proliferating Ki67-positive, apoptotic cleaved caspase-3-positive, and type I, II, and III taste cells in fungiform papillae using confocal

imaging as in Aim 1. The effects of genotype, LPS, gender and time will be identified with mixed-model analyses.

Expected outcomes. Based on widespread ACE2 expression in taste buds (Fig. 2) we expect LPS treatment to suppress responses to multiple taste qualities in *LE-Ace2* KO as taste cell turnover is dysregulated[54,147]. In LPS-treated control littermates, we expect elevated Na^+ responses, inflammatory cytokine levels, and leukocyte responses based on previous results[54,145-149]. We expect *LE-Ace2* KO to exacerbate inflammatory responses to LPS in as in other tissues[31]. A common caveat in the field is that *Ace2* will be deleted in taste cells and lingual keratinocytes because of their shared K14+ lineage[152]. Thus, neural taste changes could be due to taste cell based or indirect mechanisms.

Alternative outcomes and potential pitfalls. The techniques are standard to the field and our laboratories so no difficulties are anticipated. If CT responses to LPS are unaffected by *LE-Ace2* at 6 or 24 hr we will extend survival time with s.c. fluid and record at day 2. However, taste bud levels of the cellular activity marker *c-fos* are suppressed at 6 hr after LPS injection so this is unexpected[147]. ACE2 may play a fundamental role in salt taste in addition to its potential function as a SARS-CoV-2 receptor similar to its dual functions in the lung, kidney, and cardiovascular system[30,31,153,154]. In that case amiloride-sensitive CT responses may be altered in vehicle-treated LE-Ace2 KO.

Aim 2b. *We will record neural responses and measure taste cell dynamics in hAce2-KI which recapitulate endogenous Ace2 expression. Mice will be challenged with LPS and/or a human SARS-CoV-2 spike-Fc fusion protein to determine the impact on taste function.*

Rationale. In this aim we determine the effect of human spike-Fc protein on inflammatory responses, taste bud composition, taste cell dynamics, and neural taste, tactile and temperature responses in mice expressing human *Ace2*. Fc-fusion proteins have improved stability and solubility *in vivo*[155], and this strategy has been successful in demonstrating ACE2-mediated mechanisms of lung injury during SARS-CoV infection[49,51,52]. Results from this aim will contribute to our understanding of how SARS-CoV-2 causes taste deficits and strategies that might be used to treat long-term aguesia.

Methods. CT recordings, LPS injections, analyses of inflammatory responses by ELISA, qPCR, immunofluorescence, taste cell confocal analyses and statistical analyses will be performed as described above. Groups of *hAce2-KI* mice and heterozygous littermates will be injected with LPS or PBS (i.p.). Human spike-Fc or control-Fc protein will be administered i.p. three times at 30 min before, 1 hr after, and 2 hr after LPS injections (n=5 mice/gender)[52]. We will record from the CT and harvest samples at 6 hr after LPS injections since group differences emerged within hours in lung[52]. Antibodies to the receptor binding domain of the human spike protein will be used to measure spike-Fc in Western blots on anterior lingual epithelium and lung lysates and in cryosections from anterior tongue co-labelled with type I, II, and III taste cell markers.

Expected outcomes. We predict that spike-Fc injection will exacerbate inflammatory responses to LPS, reduce taste progenitor proliferation, increase taste cell death, alter the proportion of type I, II, and III taste cells, and decrease CT responses to multiple taste qualities more dramatically than LPS alone.

Unexpected outcomes and potential pitfalls. If taste buds and CT responses are unaffected by LPS plus spike-Fc protein we will extend the survival period to 2 days post-LPS. LPS rapidly affects taste buds[54,145-149], however, and taste deficits appear to be early symptoms of SARS-CoV-2 infection[156]. We could also deliver spike-Fc intranasally and/or i.v., though our goal is to test reactivity to the viral protein rather than immunize mice[157] and human spike-Fc protein was administered systemically in lung models[50,52]. If taste function is unaffected by treatment we would also test commercially-available h*Ace2*-KI mice (JAX #035000).

Timeline

We are breeding mice and will have established breeding colonies by the start of year 1. We will begin Aim 1 and neurophysiological studies for Aims 2a and 2b immediately. We expect to complete Aim 1 by the end of year 1 and CT recordings by the end of year 1.5. Immunological and immunofluorescent assays for Aims 2a and 2b will be ongoing as tissue is added. This allows time to complete all experiments before the end of year 2 even if additional groups surviving 2 days are added.

4. Future Studies

We will test whether taste behavior is altered in *LE-Ace2 KO* and *hAce2-KI* mice receiving LPS and spike-Fc protein with collaborator Dr. David Pittman[138]. A priority is to test whether exogenous ACE2 or the Ang II receptor antagonist, Losartan, ameliorates inflammation, structural changes in taste buds, and neural and behavioral taste deficits. We will also determine whether pseudotyped human SARS-CoV-2 virus, which can be used in BSL2 facilities[63], recapitulates mechanisms underlying taste loss in *hAce2-KI* mice.

BIBLIOGRAPHY

1 Dawson, P. *et al.* Loss of Taste and Smell as Distinguishing Symptoms of COVID-19. *Clin. Infect. Dis.*, (2020).

2 Parma, V. *et al.* More than smell - COVID-19 is associated with severe impairment of smell, taste, and chemesthesis. *Chem. Senses*, (2020).

3 Vaira, L. A., Salzano, G., Fois, A. G., Piombino, P. & De Riu, G. Potential pathogenesis of ageusia and anosmia in COVID-19 patients. *Int Forum Allergy Rhinol* **10**, 1103-1104, (2020).

4 von Bartheld, C. S., Hagen, M. M. & Butowt, R. Prevalence of Chemosensory Dysfunction in COVID-19 Patients: A Systematic Review and Meta-analysis Reveals Significant Ethnic Differences. *ACS Chem. Neurosci.*, (2020).

5 Chen, X. *et al.* A systematic review of neurological symptoms and complications of COVID-19. *J. Neurol.*, 1-11, (2020).

6 Lechien, J. R. *et al.* Gustatory dysfunctions in COVID-19. *Eur. Arch. Otorhinolaryngol.* **277**, 2397-2398, (2020).

7 Iravani, B. *et al.* Relationship between odor intensity estimates and COVID-19 prevalence prediction in a Swedish population. *Chem. Senses*, (2020).

8 Lechner, M. *et al.* Course of symptoms for loss of sense of smell and taste over time in one thousand forty-one healthcare workers during the Covid-19 pandemic: Our experience. *Clin. Otolaryngol.* **46**, 451-457, (2021).

9 Ninchritz-Becerra, E. *et al.* Subjective evaluation of smell and taste dysfunction in patients with mild COVID-19 in Spain. *Med Clin (Engl Ed)* **156**, 61-64, (2021).

10 Pierron, D. *et al.* Smell and taste changes are early indicators of the COVID-19 pandemic and political decision effectiveness. *Nature Communications* **11**, 5152, (2020).

11 Morlock, R., Morlock, A., Downen, M. & Shah, S. N. COVID-19 prevalence and predictors in United States adults during peak stay-at-home orders. *PLoS One* **16**, e0245586, (2021).

12 Gerkin, R. C. *et al.* Recent Smell Loss Is the Best Predictor of COVID-19 Among Individuals With Recent Respiratory Symptoms. *Chem. Senses* **46**, (2021).

13 Henkin, R. I., Larson, A. L. & Powell, R. D. Hypogeusia, dysgeusia, hyposmia, and dysosmia following influenza-like infection. *Ann. Otol. Rhinol. Laryngol.* **84**, 672-682, (1975).

14 Mott, A. E. & Leopold, D. A. Disorders in taste and smell. *Med. Clin. North Am.* **75**, 1321-1353, (1991).

15 Wang, H., Zhou, M., Brand, J. & Huang, L. Inflammation and taste disorders: mechanisms in taste buds. *Ann. N. Y. Acad. Sci.* **1170**, 596-603, (2009).

16 Klein, H. *et al.* Onset, duration, and persistence of taste and smell changes and other COVID-19 symptoms: longitudinal study in Israeli patients. *medRxiv*, 2020.2009.2025.20201343, (2020).

17 Vaira, L. A. *et al.* Smell and taste recovery in coronavirus disease 2019 patients: a 60-day objective and prospective study. *J. Laryngol. Otol.* **134**, 703-709, (2020).

18 Petersen, M. S. *et al.* Long COVID in the Faroe Islands - a longitudinal study among non-hospitalized patients. *Clin. Infect. Dis.*, (2020).

19 Schwab, J., Jensen, C. D. & Fjaeldstad, A. W. Sustained Chemosensory Dysfunction during the COVID-19 Pandemic. *ORL J. Otorhinolaryngol. Relat. Spec.* **83**, 209-218, (2021).

20 Bromley, S. M. Smell and taste disorders: a primary care approach. *Am. Fam. Physician* **61**, 427-436, 438, (2000).

21 Deems, D. A. *et al.* Smell and taste disorders, a study of 750 patients from the University of Pennsylvania Smell and Taste Center. *Arch. Otolaryngol. Head Neck Surg.* **117**, 519-528, (1991).

22 Schiffman, S. S. Taste and smell in disease (second of two parts). *N. Engl. J. Med.* **308**, 1337-1343, (1983).

23 Snyder, D. J. & Bartoshuk, L. M. Oral sensory nerve damage: Causes and consequences. *Rev. Endocr. Metab. Disord.* **17**, 149-158, (2016).

24 Doty, R. L. in *Handb. Clin. Neurol.* Vol. 164 (ed Richard L. Doty) 3-13 (Elsevier, 2019).

25 Dudine, L. *et al.* Investigation on the Loss of Taste and Smell and Consequent Psychological Effects: A Cross-Sectional Study on Healthcare Workers Who Contracted the COVID-19 Infection. *Front Public Health* **9**, 666442, (2021).

26 Trübner, F. *et al.* Predictors of COVID-19 in an outpatient fever clinic. *PLoS One* **16**, e0254990, (2021).

27 Hu, B., Guo, H., Zhou, P. & Shi, Z.-L. Characteristics of SARS-CoV-2 and COVID-19. *Nature Reviews Microbiology*, (2020).

28 Hoffmann, M. *et al.* SARS-CoV-2 Cell Entry Depends on ACE2 and TMPRSS2 and Is Blocked by a Clinically Proven Protease Inhibitor. *Cell* **181**, 271-280.e278, (2020).
29 Zhou, P. *et al.* A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* **579**, 270-273, (2020).
30 Gheblawi, M. *et al.* Angiotensin-Converting Enzyme 2: SARS-CoV-2 Receptor and Regulator of the Renin-Angiotensin System. *Circ. Res.* **126**, 1456-1474, (2020).
31 Ni, W. *et al.* Role of angiotensin-converting enzyme 2 (ACE2) in COVID-19. *Critical Care* **24**, 422, (2020).
32 Gupta, A. *et al.* Extrapulmonary manifestations of COVID-19. *Nat. Med.* **26**, 1017-1032, (2020).
33 Shang, J. *et al.* Cell entry mechanisms of SARS-CoV-2. *Proceedings of the National Academy of Sciences* **117**, 11727-11734, (2020).
34 Cantuti-Castelvetri, L. *et al.* Neuropilin-1 facilitates SARS-CoV-2 cell entry and infectivity. *Science*, eabd2985, (2020).
35 Soundararajan, R., Pearce, D. & Ziera, T. The role of the ENaC-regulatory complex in aldosterone-mediated sodium transport. *Mol. Cell. Endocrinol.* **350**, 242-247, (2012).
36 Chandrashekar, J. *et al.* The cells and peripheral representation of sodium taste in mice. *Nature* **464**, 297-301, (2010).
37 Brand, J. G., Teeter, J. H. & Silver, W. L. Inhibition by amiloride of chorda tympani responses evoked by monovalent salts. *Brain Res.* **334**, 207-214, (1985).
38 Heck, G. L., Mierson, S. & DeSimone, J. A. Salt taste transduction occurs through an amiloride-sensitive sodium transport pathway. *Science* **223**, 403-405, (1984).
39 Feldman, G. M. *et al.* Salt-evoked lingual surface potential in humans. *J. Neurophysiol.* **90**, 2060-2064, (2003).
40 Lin, W., Finger, T. E., Rossier, B. C. & Kinnamon, S. C. Epithelial Na+ channel subunits in rat taste cells: localization and regulation by aldosterone. *J. Comp. Neurol.* **405**, 406-420, (1999).
41 Herness, M. S. Aldosterone increases the amiloride-sensitivity of the rat gustatory neural response to NaCl. *Comp. Biochem. Physiol. Comp. Physiol.* **103**, 269-273, (1992).
42 Guagliardo, N. A., West, K. N., McCluskey, L. P. & Hill, D. L. Attenuation of peripheral salt taste responses and local immune function contralateral to gustatory nerve injury: effects of aldosterone. *Am. J. Physiol. Regul. Integr. Comp. Physiol.* **297**, R1103-1110, (2009).
43 Sakamoto, T., Fujii, A., Saito, N., Kondo, H. & Ohuchi, A. Alteration of amiloride-sensitive salt taste nerve responses in aldosterone/NaCl-induced hypertensive rats. *Neurosci. Res.* **108**, 60-66, (2016).
44 Ferreira, N. S., Tostes, R. C., Paradis, P. & Schiffrin, E. L. Aldosterone, Inflammation, Immune System, and Hypertension. *Am. J. Hypertens.*, (2020).
45 Yoshida, K. *et al.* Excess aldosterone under normal salt diet induces cardiac hypertrophy and infiltration via oxidative stress. *Hypertens. Res.* **28**, 447-455, (2005).
46 Sun, Y. *et al.* Aldosterone-induced inflammation in the rat heart : role of oxidative stress. *The American journal of pathology* **161**, 1773-1781, (2002).
47 Shigemura, N. *et al.* Angiotensin II modulates salty and sweet taste sensitivities. *J. Neurosci.* **33**, 6267-6277, (2013).
48 Luchiari, H. R., Giordano, R. J., Sidman, R. L., Pasqualini, R. & Arap, W. Does the RAAS play a role in loss of taste and smell during COVID-19 infections? *The pharmacogenomics journal* **21**, 109-115, (2021).
49 Imai, Y., Kuba, K., Ohto-Nakanishi, T. & Penninger, J. M. Angiotensin-converting enzyme 2 (ACE2) in disease pathogenesis. *Circ. J.* **74**, 405-410, (2010).
50 Imai, Y. *et al.* Angiotensin-converting enzyme 2 protects from severe acute lung failure. *Nature* **436**, 112-116, (2005).
51 Kuba, K., Imai, Y., Ohto-Nakanishi, T. & Penninger, J. M. Trilogy of ACE2: a peptidase in the renin-angiotensin system, a SARS receptor, and a partner for amino acid transporters. *Pharmacol. Ther.* **128**, 119-128, (2010).
52 Kuba, K. *et al.* A crucial role of angiotensin converting enzyme 2 (ACE2) in SARS coronavirus–induced lung injury. *Nat. Med.* **11**, 875-879, (2005).
53 Ye, R. & Liu, Z. ACE2 exhibits protective effects against LPS-induced acute lung injury in mice by inhibiting the LPS-TLR4 pathway. *Exp. Mol. Pathol.* **113**, 104350, (2020).

54 Cohn, Z. J., Kim, A., Huang, L., Brand, J. & Wang, H. Lipopolysaccharide-induced inflammation attenuates taste progenitor cell proliferation and shortens the life span of taste bud cells. *BMC Neurosci.* **11**, 72, (2010).
55 Feng, P., Zhao, H., Chai, J., Huang, L. & Wang, H. Expression and secretion of TNF-alpha in mouse taste buds: a novel function of a specific subset of type II taste cells. *PLoS One* **7**, e43140, (2012).
56 Sakaguchi, W. *et al.* Existence of SARS-CoV-2 Entry Molecules in the Oral Cavity. *Int. J. Mol. Sci.* **21**, (2020).
57 Xu, H. *et al.* High expression of ACE2 receptor of 2019-nCoV on the epithelial cells of oral mucosa. *Int J Oral Sci* **12**, 8, (2020).
58 Huang, N. *et al.* SARS-CoV-2 infection of the oral cavity and saliva. *Nat. Med.*, (2021).
59 Zhong, M. *et al.* ACE2 and Furin Expressions in Oral Epithelial Cells Possibly Facilitate COVID-19 Infection via Respiratory and Fecal–Oral Routes. *Frontiers in Medicine* **7**, (2020).
60 Han, Q., Peng, J., Xu, H. & Chen, Q. Taste cell is abundant in the expression of Ace2 receptor of 2019-nCoV. *Preprints*, 2020040424 (doi: 2020040410.2020020944/preprints2020202004.2020040424.v2020040421), (2020).
61 Doyle, M. E. *et al.* Human Type II Taste Cells Express Angiotensin-Converting Enzyme 2 and Are Infected by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). *Am. J. Pathol.*, (2021).
62 Wang, Z. *et al.* SARS-CoV-2 Receptor ACE2 Is Enriched in a Subpopulation of Mouse Tongue Epithelial Cells in Nongustatory Papillae but Not in Taste Buds or Embryonic Oral Epithelium. *ACS Pharmacol Transl Sci* **3**, 749-758, (2020).
63 Cooper, K. W. *et al.* COVID-19 and the Chemical Senses: Supporting Players Take Center Stage. *Neuron* **107**, 219-233, (2020).
64 Shigemura, N. *et al.* Expression of Renin-Angiotensin System Components in the Taste Organ of Mice. *Nutrients* **11**, 2251, (2019).
65 Sato, T. *et al.* Expression of ACE2 and TMPRSS2 proteins in the upper and lower aerodigestive tracts of rats: implications on COVID 19 infections. *Laryngoscope*, (2020).
66 Knapp, L., Lawton, A., Oakley, B., Wong, L. & Zhang, C. Keratins as markers of differentiated taste cells of the rat. *Differentiation* **58**, 341-349, (1995).
67 Wiener, R. S., Cao, Y. X., Hinds, A., Ramirez, M. I. & Williams, M. C. Angiotensin converting enzyme 2 is primarily epithelial and is developmentally regulated in the mouse lung. *J. Cell. Biochem.* **101**, 1278-1291, (2007).
68 Schuler, B. A. *et al.* Age-determined expression of priming protease TMPRSS2 and localization of SARS-CoV-2 in lung epithelium. *J. Clin. Invest.* **131**, (2021).
69 Tang, Q. *et al.* GfiQ GCE inducible Cre line for hair cell specific gene manipulation in mouse inner ear. *genesis* **57**, (2019).
70 Pellegrino, R. *et al.* Corona Viruses and the Chemical Senses: Past, Present, and Future. *Chem. Senses*, (2020).
71 Benton, D. J. *et al.* Receptor binding and priming of the spike protein of SARS-CoV-2 for membrane fusion. *Nature*, (2020).
72 Cantuti-Castelvetri, L. *et al.* Neuropilin-1 facilitates SARS-CoV-2 cell entry and infectivity. *Science* **370**, 856-860, (2020).
73 Daly, J. L. *et al.* Neuropilin-1 is a host factor for SARS-CoV-2 infection. *Science* **370**, 861-865, (2020).
74 Li, W. *et al.* Efficient Replication of Severe Acute Respiratory Syndrome Coronavirus in Mouse Cells Is Limited by Murine Angiotensin-Converting Enzyme 2. *J. Virol.* **78**, 11429-11433, (2004).
75 Zheng, J. *et al.* COVID-19 treatments and pathogenesis including anosmia in K18-hACE2 mice. *Nature*, (2020).
76 Netland, J., Meyerholz, D. K., Moore, S., Cassell, M. & Perlman, S. Severe Acute Respiratory Syndrome Coronavirus Infection Causes Neuronal Death in the Absence of Encephalitis in Mice Transgenic for Human ACE2. *J. Virol.* **82**, 7264-7275, (2008).
77 Zeng, Q., Lawton, A. & Oakley, B. Glycoconjugates and keratin 18 define subsets of taste cells. *Histochem. J.* **27**, 997-1006, (1995).
78 Zhang, C. *et al.* Keratin 18 is associated with a subset of older taste cells in the rat. *Differentiation* **59**, 155-162, (1995).
79 Witt, M. & Kasper, M. Distribution of cytokeratin filaments and vimentin in developing human taste buds. *Anat. Embryol. (Berl.)* **199**, 291-299, (1999).

80 Zhou, B. *et al.* SARS-CoV-2 spike D614G change enhances replication and transmission. *Nature* **592**, 122-127, (2021).
81 Takahashi, T. *et al.* Sex differences in immune responses that underlie COVID-19 disease outcomes. *Nature*, (2020).
82 Bártová, E., Legartová, S., Krejčí, J. & Arcidiacono, O. A. Cell differentiation and aging accompanied by depletion of the ACE2 protein. *Aging (Albany N. Y.)* **12**, (2020).
83 Moradi, F., Enjezab, B. & Ghadiri-Anari, A. The role of androgens in COVID-19. *Diabetes Metab. Syndr.* **14**, 2003-2006, (2020).
84 Bienvenu, L. A., Noonan, J., Wang, X. & Peter, K. Higher mortality of COVID-19 in males: Sex differences in immune response and cardiovascular comorbidities. *Cardiovasc. Res.*, (2020).
85 Gagliardi, M. C., Tieri, P., Ortona, E. & Ruggieri, A. ACE2 expression and sex disparity in COVID-19. *Cell Death Discovery* **6**, 37, (2020).
86 Han, T., Kang, J., Li, G., Ge, J. & Gu, J. Analysis of 2019-nCoV receptor ACE2 expression in different tissues and its significance study. *Ann Transl Med* **8**, 1077, (2020).
87 Khan, N. Possible protective role of 17β-estradiol against COVID-19. *J Allergy Infect Dis* **1**, 38-48, (2020).
88 Petrocelli, M. *et al.* Remote psychophysical evaluation of olfactory and gustatory functions in early-stage coronavirus disease 2019 patients: the Bologna experience of 300 cases. *J. Laryngol. Otol.* **134**, 571-576, (2020).
89 Roper, S. D. & Chaudhari, N. Taste buds: cells, signals and synapses. *Nat. Rev. Neurosci.* **18**, 485-497, (2017).
90 Xia, H. & Lazartigues, E. Angiotensin-converting enzyme 2: central regulator for cardiovascular function. *Curr. Hypertens. Rep.* **12**, 170-175, (2010).
91 Xu, P., Sriramula, S. & Lazartigues, E. ACE2/ANG-(1-7)/Mas pathway in the brain: the axis of good. *Am. J. Physiol. Regul. Integr. Comp. Physiol.* **300**, R804-817, (2011).
92 Doobay, M. F. *et al.* Differential expression of neuronal ACE2 in transgenic mice with overexpression of the brain renin-angiotensin system. *American journal of physiology. Regulatory, integrative and comparative physiology* **292**, R373-R381, (2007).
93 Nampoothiri, S. *et al.* The hypothalamus as a hub for putative SARS-CoV-2 brain infection. *bioRxiv*, 2020.2006.2008.139329, (2020).
94 McCray, P. B. *et al.* Lethal Infection of K18-hACE2 Mice Infected with Severe Acute Respiratory Syndrome Coronavirus. *J. Virol.* **81**, 813-821, (2007).
95 Song, E. *et al.* Neuroinvasion of SARS-CoV-2 in human and mouse brain. *bioRxiv*, (2020).
96 Qiao, J. *et al.* The expression of SARS-CoV-2 receptor ACE2 and CD147, and protease TMPRSS2 in human and mouse brain cells and mouse brain tissues. *Biochem. Biophys. Res. Commun.* **533**, 867-871, (2020).
97 Rathnasinghe, R. *et al.* Comparison of transgenic and adenovirus hACE2 mouse models for SARS-CoV-2 infection. *Emerg Microbes Infect* **9**, 2433-2445, (2020).
98 Sun, S. H. *et al.* A Mouse Model of SARS-CoV-2 Infection and Pathogenesis. *Cell Host Microbe* **28**, 124-133.e124, (2020).
99 Barrantes, F. J. Central Nervous System Targets and Routes for SARS-CoV-2: Current Views and New Hypotheses. *ACS Chem. Neurosci.* **11**, 2793-2803, (2020).
100 Lukiw, W. J., Pogue, A. & Hill, J. M. SARS-CoV-2 Infectivity and Neurological Targets in the Brain. *Cell. Mol. Neurobiol.*, 1-8, (2020).
101 Yi, S. A. *et al.* Infection of Brain Organoids and 2D Cortical Neurons with SARS-CoV-2 Pseudovirus. *Viruses* **12**, (2020).
102 Bryche, B. *et al.* Massive transient damage of the olfactory epithelium associated with infection of sustentacular cells by SARS-CoV-2 in golden Syrian hamsters. *Brain. Behav. Immun.* **89**, 579-586, (2020).
103 Rolls, E. T. Taste and smell processing in the brain. *Handb. Clin. Neurol.* **164**, 97-118, (2019).
104 Lu, J. *et al.* The expression of angiotensin-converting enzyme 2-angiotensin-(1-7)-Mas receptor axis are upregulated after acute cerebral ischemic stroke in rats. *Neuropeptides* **47**, 289-295, (2013).
105 Vargas, G. *et al.* Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and glial cells: Insights and perspectives. *Brain, Behavior, & Immunity - Health* **7**, 100127, (2020).
106 Song, E. *et al.* Neuroinvasion of SARS-CoV-2 in human and mouse brain. *J. Exp. Med.* **218**, (2021).

107 Boggs, K. *et al.* Contribution of Underlying Connective Tissue Cells to Taste Buds in Mouse Tongue and Soft Palate. *PLoS One* **11**, e0146475, (2016).
108 Gaillard, D., Xu, M., Liu, F., Millar, S. E. & Barlow, L. A. beta-Catenin Signaling Biases Multipotent Lingual Epithelial Progenitors to Differentiate and Acquire Specific Taste Cell Fates. *PLoS Genet.* **11**, e1005208, (2015).
109 Vandenbeuch, A. *et al.* Role of the ectonucleotidase NTPDase2 in taste bud function. *Proc. Natl. Acad. Sci. U. S. A.* **110**, 14789-14794, (2013).
110 Chaudhari, N. & Roper, S. D. The cell biology of taste. *J. Cell Biol.* **190**, 285-296, (2010).
111 Meng, L., Ohman-Gault, L., Ma, L. & Krimm, R. F. Taste Bud-Derived BDNF Is Required to Maintain Normal Amounts of Innervation to Adult Taste Buds. *eNeuro* **2**, (2015).
112 Chandrashekar, J. *et al.* The taste of carbonation. *Science* **326**, 443-445, (2009).
113 Nguyen, H. M., Reyland, M. E. & Barlow, L. A. Mechanisms of taste bud cell loss after head and neck irradiation. *J. Neurosci.* **32**, 3474-3484, (2012).
114 Tu, Y.-H. *et al.* An evolutionarily conserved gene family encodes proton-selective ion channels. *Science* **359**, 1047, (2018).
115 Ren, W. *et al.* Single Lgr5- or Lgr6-expressing taste stem/progenitor cells generate taste bud cells ex vivo. *Proc. Natl. Acad. Sci. U. S. A.* **111**, 16401-16406, (2014).
116 Takeda, N. *et al.* Lgr5 Identifies Progenitor Cells Capable of Taste Bud Regeneration after Injury. *PLoS One* **8**, e66314, (2013).
117 Yee, K. K. *et al.* Lgr5-EGFP marks taste bud stem/progenitor cells in posterior tongue. *Stem Cells* **31**, 992-1000, (2013).
118 Barlow, L. A. & Klein, O. D. Developing and regenerating a sense of taste. *Curr. Top. Dev. Biol.* **111**, 401-419, (2015).
119 Meng, L., Huang, T., Sun, C., Hill, D. L. & Krimm, R. BDNF is required for taste axon regeneration following unilateral chorda tympani nerve section. *Exp. Neurol.* **293**, 27-42, (2017).
120 Ishida, Y. *et al.* P2X2- and P2X3-positive fibers in fungiform papillae originate from the chorda tympani but not the trigeminal nerve in rats and mice. *J. Comp. Neurol.* **514**, 131-144, (2009).
121 Kumari, A. *et al.* Hedgehog pathway blockade with the cancer drug LDE225 disrupts taste organs and taste sensation. *J. Neurophysiol.* **113**, 1034-1040, (2015).
122 Ohman-Gault, L., Huang, T. & Krimm, R. The transcription factor Phox2b distinguishes between oral and non-oral sensory neurons in the geniculate ganglion. *J. Comp. Neurol.*, (2017).
123 Dvoryanchikov, G. *et al.* Transcriptomes and neurotransmitter profiles of classes of gustatory and somatosensory neurons in the geniculate ganglion. *Nat Commun* **8**, 760, (2017).
124 Kumari, A. *et al.* Recovery of taste organs and sensory function after severe loss from Hedgehog/Smoothened inhibition with cancer drug sonidegib. *Proc. Natl. Acad. Sci. U. S. A.* **114**, E10369-e10378, (2017).
125 Moayedi, Y., Duenas-Bianchi, L. F. & Lumpkin, E. A. Somatosensory innervation of the oral mucosa of adult and aging mice. *Scientific Reports* **8**, 9975, (2018).
126 Lee, M. K., Rebhun, L. I. & Frankfurter, A. Posttranslational modification of class III beta-tubulin. *Proc. Natl. Acad. Sci. U. S. A.* **87**, 7195-7199, (1990).
127 Eme-Scolan, E. & Dando, S. J. Tools and Approaches for Studying Microglia In vivo. *Front. Immunol.* 11, (2020).
128 Woodfin, A., Voisin, M.-B. & Nourshargh, S. PECAM-1: A Multi-Functional Molecule in Inflammation and Vascular Biology. *Arterioscler. Thromb. Vasc. Biol.* **27**, 2514-2523, (2007).
129 Solomon, T. Neurological infection with SARS-CoV-2 - the story so far. *Nat. Rev. Neurol.* **17**, 65-66, (2021).
130 McMahon, C. L., Staples, H., Gazi, M., Carrion, R. & Hsieh, J. SARS-CoV-2 targets glial cells in human cortical organoids. *Stem Cell Reports* **16**, 1156-1164, (2021).
131 Bartel, D. L. & Finger, T. E. Reactive microglia after taste nerve injury: comparison to nerve injury models of chronic pain. *F1000Research* **2**, 65-65, (2013).
132 Tokita, K., Inoue, T. & Boughter, J. D., Jr. Afferent connections of the parabrachial nucleus in C57BL/6J mice. *Neuroscience* **161**, 475-488, (2009).
133 Fletcher, M. L., Ogg, M. C., Lu, L., Ogg, R. J. & Boughter, J. D. Overlapping Representation of Primary Tastes in a Defined Region of the Gustatory Cortex. *The Journal of Neuroscience* **37**, 7595-7605, (2017).

134 Tappan, S. J. *et al.* Automatic navigation system for the mouse brain. *J. Comp. Neurol.* **527**, 2200-2211, (2019).
135 Bestle, D. *et al.* TMPRSS2 and furin are both essential for proteolytic activation of SARS-CoV-2 in human airway cells. *Life science alliance* **3**, e202000786, (2020).
136 Brann, D. H. *et al.* Non-neuronal expression of SARS-CoV-2 entry genes in the olfactory system suggests mechanisms underlying COVID-19-associated anosmia. *Science Advances*, eabc5801, (2020).
137 Suárez-Fariñas, M. *et al.* Intestinal inflammation modulates the expression of ACE2 and TMPRSS2 and potentially overlaps with the pathogenesis of SARS-CoV-2 related disease. *bioRxiv*, 2020.2005.2021.109124, (2020).
138 Pittman, D. W. *et al.* Behavioral and neurophysiological taste responses to sweet and salt are diminished in a model of subclinical intestinal inflammation. *Sci. Rep.* **10**, 17611, (2020).
139 Zhu, X., He, L. & McCluskey, L. P. Ingestion of bacterial lipopolysaccharide inhibits peripheral taste responses to sucrose in mice. *Neuroscience* **258**, 47-61, (2014).
140 Balasubramanian, R., Bui, A., Xie, X., Deng, M. & Gan, L. Generation and characterization of Lhx9-GFPCreER(T2) knock-in mouse line. *Genesis* **52**, 827-832, (2014).
141 Whitney, I. E. *et al.* Genetic modulation of horizontal cell number in the mouse retina. *Proc. Natl. Acad. Sci. U. S. A.* **108**, 9697-9702, (2011).
142 Yang, H. *et al.* Gfi1-Cre knock-in mouse line: A tool for inner ear hair cell-specific gene deletion. *Genesis* **48**, 400-406, (2010).
143 Yang, H., Xie, X., Deng, M., Chen, X. & Gan, L. Generation and characterization of Atoh1-Cre knock-in mouse line. *Genesis* **48**, 407-413, (2010).
144 He, L., Yadgarov, A., Sharif, S. & McCluskey, L. P. Aging profoundly delays functional recovery from gustatory nerve injury. *Neuroscience* **209**, 208-218, (2012).
145 Kumarhia, D., He, L. & McCluskey, L. P. Inflammatory stimuli acutely modulate peripheral taste function. *J. Neurophysiol.* **115**, 2964-2975, (2016).
146 Feng, P. *et al.* Interleukin-10 is produced by a specific subset of taste receptor cells and critical for maintaining structural integrity of mouse taste buds. *J. Neurosci.* **34**, 2689-2701, (2014).
147 Wang, H., Zhou, M., Brand, J. & Huang, L. Inflammation activates the interferon signaling pathways in taste bud cells. *J. Neurosci.* **27**, 10703-10713, (2007).
148 McCluskey, L. P. Up-regulation of activated macrophages in response to degeneration in the taste system: effects of dietary sodium restriction. *J. Comp. Neurol.* **479**, 43-55, (2004).
149 Steen, P. W., Shi, L., He, L. & McCluskey, L. P. Neutrophil responses to injury or inflammation impair peripheral gustatory function. *Neuroscience* **167**, 894-908, (2010).
150 Cavallin, M. A. & McCluskey, L. P. Lipopolysaccharide-induced up-regulation of activated macrophages in the degenerating taste system. *J. Neurosci. Res.* **80**, 75-84, (2005).
151 Shi, L., He, L., Sarvepalli, P. & McCluskey, L. P. Functional role for interleukin-1 in the injured peripheral taste system. *J. Neurosci. Res.* **90**, 816-830, (2012).
152 Barlow, L. A. Progress and renewal in gustation: new insights into taste bud development. *Development* **142**, 3620-3629, (2015).
153 Domingo, P. *et al.* The four horsemen of a viral Apocalypse: The pathogenesis of SARS-CoV-2 infection (COVID-19). *EBioMedicine* **58**, 102887, (2020).
154 Anand, P., Puranik, A., Aravamudan, M., Venkatakrishnan, A. J. & Soundararajan, V. SARS-CoV-2 strategically mimics proteolytic activation of human ENaC. *eLife* **9**, e58603, (2020).
155 Czajkowsky, D. M., Hu, J., Shao, Z. & Pleass, R. J. Fc-fusion proteins: new developments and future perspectives. *EMBO Mol. Med.* **4**, 1015-1028, (2012).
156 Samaranayake, L. P., Fakhruddin, K. S. & Panduwawala, C. Sudden onset, acute loss of taste and smell in coronavirus disease 2019 (COVID-19): a systematic review. *Acta Odontol. Scand.* **78**, 467-473, (2020).
157 Hassan, A. O. *et al.* A SARS-CoV-2 Infection Model in Mice Demonstrates Protection by Neutralizing Antibodies. *Cell* **182**, 744-753.e744, (2020).

Training Obligations - Grouper Instructions

Overview:

Lab training obligations within Vector Solutions are managed through Grouper. Formerly overseen by the Safety Office, this responsibility has been delegated to individual departments. This comprehensive set of instructions will walk you through the seamless assignment of lab training duties to students, staff, and faculty within your department.

Training is essential for the safety of our university community and is an obligation for everyone to fulfill. By ensuring that all members are equipped with the necessary knowledge and skills, we create a more secure environment where everyone can thrive. Let's prioritize our collective responsibility and commitment to training for the well-being of all.

General Guidelines:

- **Grouper Knowledge Base:** For all things Grouper, access the knowledge base. There you will find the login link, how to use Grouper, bulk upload instruction, Grouper attestation, and more.
- **Active Lab List**: How you manage your groups will be up to you but keeping a current and up to date lab user list will make Grouper additions quick and easy.
- **Training Assignment:** There will be 9 folders dedicated to laboratory training obligations. They correspond to their training course. For example (we'll use department ABEN) the folder *ABEN Laboratory Safety Training* will assign anyone in that folder to *Laboratory Safety Training* in Vector Solutions. The folder *ABEN Lab Safety for PI* will assign anyone in that folder *Laboratory Safety Training for Principal Investigators* in Vector Solutions. So on and so forth. As stated in the CHP, training must cover the hazards of the work space and is determined by department chair or head. The Safety Office website has a list of trainings and the topics they cover.
- **When to Set Obligations:** The majority of training courses for the University are renewed on July 1, including laboratory safety trainings. It's crucial to bear this timeline in mind when entering obligations. Communication from HR or the Safety Office will outline the timeframe for entering obligations before July 1 for the upcoming fiscal year's training requirements. Any obligations entered after July 1 will be correctly assigned in Vector. For example, incoming grad students can be assigned training obligations anytime after July 1 for the Fall semester.

Instructions:

1. Locate the folder for the training obligation you want to assign.
2. Add members. You can add a single member or select group actions > import members. From there you can copy and paste a list of EMPL or Student ID numbers. This is where the lab user list becomes a time saver. For anyone you do not have an ID number for search by name.

3. Add an end date that is meaningful to you. This can be the end of the semester or the end of the fiscal year at which point the member will be removed from the group. It will help keep your groups clean and organized and make attestation a breeze. You may also go in and add or remove a member at any time. Adding an end date will ensure your folder is clear and ready for training obligations at the start of the next fiscal year.
4. Click submit. You will be back in the folder and can see how many members were uploaded and if there were any errors.

Things to know and do:

- Only those with Grouper access and assigned to the owner/manager folders can add or delete members from the departments folders.
- The Safety Office will assign managers/owners for departments. If you need to change access or grant someone access to edit memberships, notify Christina Rodenbiker.
- If you have a non-employee that needs access to Vector Solutions the only way to do that is through Grouper assignment to a training.

Helpful Hints:

- Add your most frequently used folders to your favorites. In the folder, in the upper right select 'folder actions' > add to my favorites. Under 'Quick links' in the left side menu, your folder will now be in 'My Favorites' and easy to navigate to.
- If you need to add the same members to multiple groups - at the top of the add or remove members screen > select search for a group > enter name or search word > select search > locate and click on group to add > select close > select Add another group. That group will then be added to the folders you are adding members to.

FAQs:

If you have any questions regarding this process email christina.rodenbiker@ndsu.edu. Below are some questions that you may have.

- **Will removing someone from a folder remove their obligation in Vector Solutions?**
  - No, removing someone from a group after a training has been assigned will not remove the training from their assignments in Vector Solutions. If there was a mistake in the assignment contact Kristina Astrup in HR to assist with the obligation removal.
- **What if someone does not have access to Vector Solutions?**
  - If someone does not have access to Vector Solutions assigning them an obligation through Grouper will grant them access to Vector. They use their Bison login to sign into Vector Solutions. If they are still having trouble 48 hours after they were added to the Grouper training folder, they should contact Kristina Astrup in HR.

- **How long does it take for the training they were obligated to show up in their "My Assignments" in Vector Solutions?**
  - Allow at least 24 hours for the upload from Grouper to Vector Solutions to occur. After that time the user should receive an email from Vector Solutions that they have been assigned a training to complete. If they didn't have access to Vector prior (student, non-employee) they will have access after that 24-48 hour period.
- **If I set an end date for the end of a semester, and re-add someone to the grouper list will it re-obligate the training to that person?**
  - No, if they have already completed the training in Vector Solutions it will have recorded that completion and they will not have to re-take the training.
- **What do I do if someone says they cannot access Vector?**
  - Verify that they are in a Grouper folder, specifically for the training they need to complete. Allow 24-48 hours for the information to load into Vector. If they are still having issues accessing Vector they should contact HR.

NDSU Safety Office Training Matrix

Are you an NDSU student, staff or faculty...	Complete this Laboratory Safety Training Course					
	Laboratory Safety Training	Waste Handling Training	Biosafety Training	Nanomaterial Safety Training	Radiation Safety Training	PI & Lab Supervisor Training
Working in a laboratory?	●					
Generating or handling hazardous waste or biohazard waste?	●	●				
Working in a lab where biohazardous materials or bloodborne pathogens are present?	●		●			
Working with nanomaterials?	●			●		
Working in a lab with radioactive materials or radiation producing equipment?	●				●	
In a laboratory supervisor or principal investigator role?	●	*	*	*	*	●

Instructions: Use the Training Matrix above to select the appropriate laboratory safety training courses required for lab personnel. A laboratory supervisor or principal investigator should determine which tasks or hazards are present in the laboratory and assign required (●) trainings.

Principal Investigators and Supervisors must complete the same trainings assigned to those working in their lab (*).

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SAFETY OFFICE

Training Requirements Table

Training Course	Delivery	Frequency	Required?	Date Completed
Laboratory Safety Training	Online	Annual	☒Yes ☐No	
Waste Handling Training (Initial)	In-Person	Once	☐Yes ☐No	
Waste Handling Training (Refresher)	Online	Semester	☐Yes ☐No	
Biosafety Training	Online	Annual	☐Yes ☐No	
Nanomaterial Safety Training	Online	Annual	☐Yes ☐No	
Radiation Safety Training	Online	Annual	☐Yes ☐No	
PI & Lab Supervisor Training	Online	Annual	☐Yes ☐No	
Additional Relevant Training(s)				
Click to add additional training requirements			☐Yes ☐No	
Click to add additional training requirements			☐Yes ☐No	
Click to add additional training requirements			☐Yes ☐No	
Click to add additional training requirements			☐Yes ☐No	

Instructions: Use the table above to track your laboratory safety training requirements. Your lab supervisor or principal investigator should determine the required trainings, and maintain training records for your laboratory.

Laboratory Staff Name: _____ Signature: _____

Lab Supervisor/PI Signature: _____ Date: _____

Additional information on training requirements can be found on the Safety Office training webpage: https://www.ndsu.edu/police_safety/training/.

NDSU | UNIVERSITY POLICE SAFETY OFFICE

College:

Department:

Sent to:

Submitted by:

LAST UPDATED:

LAST NAME	FIRST NAME	EMPL ID	Category	Lab safety training?	Initial Waste Tr	Refresher Waste	Bloodborne training?	Radiation Training?	Nanomaterial Training	PI/Supervisor?	PI/Supervisor	Lab Title	Building	Lab Manager
EXAMPLE: Smith	Zach	1234567	Staff	Yes	No	Yes	Yes	No	No	No	Gustafson	Safety Lab	UPSO	Gustafson

Training Requirements Table

Training Course	Delivery	Frequency	Required?	Date Completed
Laboratory Safety Training	Online	Annual	☒Yes ☐No	
Waste Handling Training (Initial)	In-Person	Once	☐Yes ☐No	
Waste Handling Training (Refresher)	Online	Semester	☐Yes ☐No	
Biosafety Training	Online	Annual	☐Yes ☐No	
Nanomaterial Safety Training	Online	Annual	☐Yes ☐No	
Radiation Safety Training	Online	Annual	☐Yes ☐No	
PI & Lab Supervisor Training	Online	Annual	☐Yes ☐No	
Additional Relevant Training(s)				
Click to add additional training requirements			☐Yes ☐No	
Click to add additional training requirements			☐Yes ☐No	
Click to add additional training requirements			☐Yes ☐No	
Click to add additional training requirements			☐Yes ☐No	

Instructions: Use the table above to track your laboratory safety training requirements. Your lab supervisor or principal investigator should determine the required trainings, and maintain training records for your laboratory.

Laboratory Staff Name: _____ Signature: _____

Lab Supervisor/PI Signature: _____ Date: _____

Additional information on training requirements can be found on the Safety Office training webpage: https://www.ndsu.edu/police_safety/training/.

NDSU | UNIVERSITY POLICE SAFETY OFFICE

NDSU Safety Office Training Matrix

Are you an NDSU student, staff or faculty...	Complete this Laboratory Safety Training Course					
	Laboratory Safety Training	Waste Handling Training	Biosafety Training	Nanomaterial Safety Training	Radiation Safety Training	PI & Lab Supervisor Training
Working in a laboratory?	●					
Generating or handling hazardous waste or biohazard waste?	●	●				
Working in a lab where biohazardous materials or bloodborne pathogens are present?	●		●			
Working with nanomaterials?	●			●		
Working in a lab with radioactive materials or radiation producing equipment?	●				●	
In a laboratory supervisor or principal investigator role?	●	*	*	*	*	●

Instructions: Use the Training Matrix above to select the appropriate laboratory safety training courses required for lab personnel. A laboratory supervisor or principal investigator should determine which tasks or hazards are present in the laboratory and assign required (●) trainings.

Principal Investigators and Supervisors must complete the same trainings assigned to those working in their lab (*).

NDSU | UNIVERSITY POLICE
SAFETY OFFICE

College:

Department:

Sent to:

Submitted by:

LAST UPDATED:

LAST NAME	FIRST NAME	EMPL ID	Category	Lab safety training?	Initial Waste Tr	Refresher Waste	Biosafety training?	Radiation Training?	Nanomaterial Trainin	PI/Supervisor/	PI/Supervisor	Lab Title	Building	Lab Manager
EXAMPLE: Smith	Zach	1234567	Staff	Yes	No	Yes	Yes	No	No	No	Gustafson	Safety Lab	UPSO	Gustafson

NDSU NORTH DAKOTA STATE UNIVERSITY

Histology Core Facility

Center for Diagnostic and Therapeutic Strategies in Pancreatic Cancer

Pharmaceutical Sciences Sudro Hall Room 134 Gwendolyn.Thomas@ndsu.edu

Histology Submission Form

Submitted by:

PI:

Department:

Telephone #:

Email address:

Preferred method of contact: ◯Phone ◯Email

PO# or grant for billing:

Lab Office Use Only:

Date Received:

Materials received: WT / B / C / S

Apply label here

Submission Requirements

1. Fill out form completely.
2. Do not submit samples in glass or non-leak proof containers.
3. Submit fixed tissue cassettes in **70% ethanol**. Samples must be fixed for **24 – 48 hours** prior to submission.
4. Label cassettes with pencil (DO NOT use a sharpie).
5. Provide slide box or folder for completed slides.
6. Log time of fixation in the space to the right. ⟶

Date placed in 70% Ethanol:

Fixative used:

Fixation time:

Write in Total Number of Samples Submitted (all types): (Details on second page)

Fixed Tissue Cassettes Wet Tissue Paraffin Blocks Glass Slides

Special Embedding Instructions:

I want to be present when tissue is embedded. Contact me at

Lab Office Use Only:

Processing Date: Completion Date: Notification Date:

NDSU NORTH DAKOTA STATE UNIVERSITY

Histology Core Facility

Apply label here

	Cassette Label Name	Species & Tissue	#H&E	#Unstained	Sections per Slide	Additional Information
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

The Histology Core is located in Sudro 134 in the department of Pharmaceutical Sciences.

Sample submission is Monday – Friday, 1:00pm-3:00pm or by appointment

Contact
Gwendolyn Thomas
Histology Core Technician

Services

Tissue Preparation

- All tissues submitted to the core must be grossed, placed in a cassette and fixed for a minimum of 24 hours, up to 48 hours, prior to submission.
    - Fixation: all tissues must be fixed prior to submission, preferably in 10% Neutral Buffered Formalin
    - Submission: all samples will be submitted in 70% ethanol
- Tissue processing; dehydration, clearing, infiltration, embedding, slide preparation and scanning.

Microtomy

- Paraffin microtomy

Histostaining

Service will include protocols, and advice on tissue processing, embedding orientation, and routine or special staining. Paraffin embedding, processing, sectioning and a staining service that will include:

- **Hematoxylin & Eosin (H&E)**: general tissue staining
- Other special stains may be available on an individual basis or will be supplied by the investigator.

Whole Sliding Scanning

Scanned images will be stored for 30 days from the day of project completed notification. The core will work with investigators to transfer data once available. After 30 days, the core is not responsible for the storage of data due to limited space.

- Diagnostic quality, high-throughput resolution images at 20X or 40X magnification

Policies

Consultation Meeting

An initial consultation meeting is highly recommended for all first time users to discuss your project goals and feasibility. Please contact the Histology core (Gwendolyn.Thomas@ndsu.edu) to schedule a consultation meeting.

Data storage

All scanned images will be stored on the core computer ***for 30 days*** after project completion notification. After that, the core is not responsible for the storage of data due to limited space. It is the responsibility of the PI to communicate with staff for image transfer.

Publication Acknowledgment

NDSU Core policies require that all facility users acknowledge the COBRE histology core facility in any published work that reports data collected and processed using core services. ***Acknowledgments can be referenced as: Histological services were provided by the NDSU Histology Core Facility supported by the Center for Diagnostic and Therapeutic Strategies in Pancreatic Cancer funds.*** The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Heath.

Sample Submission Guidelines

Consultation

An initial consultation is highly recommended for all first time users to discuss sample handling, tissue fixation, and embedding. Please contact the Histology core (Gwendolyn.Thomas@ndsu.edu) to schedule a consultation meeting.

Biosafety Considerations

- All tissues/cells must be fixed, 10% neutral buffered formalin (NBF) recommended, for a minimum of 24 hours up to 48 hours.

Turn Around Time

A standard turn-around time of approximately 5 to 10 business days is assigned to orders at the time of submission; turn-around times are dependent on complexity and size. Orders are accepted Monday through Friday, 1:00pm-3:00pm on a first-come first serve basis.

Tissue Cassette and/or Containers Labeling

- Fixed tissue samples must be submitted in a sealed container labeled with PI name, sample ID, and transport reagent (70% ETOH). Label all cassettes using a #2 lead pencil or pen specifically designed for histology labeling
    - **DO NOT USE A SHARPIE OF ANY KIND**
    - Please print clearly
    - Histology Core staff will not be held responsible for the loss of sample labels due to the use of a non-solvent resistant marker. If in doubt, test marker before use in solvent.
    - Use of a simple coding system containing no more than 8 characters is recommended.

Tissue Collection

- Cut tissues 2-3 mm thick if possible, as this allows for better penetration of fixative.
- Do not overcrowd specimens in jars or cassettes, as this hinders good fixation and proper embedding of samples.
- Samples will not be grossed by staff. The sample will be processed as received.

Tissue Fixation

- Place tissue in fixative immediately to prevent autolysis.
- Cover tissue with 10-20 times its own volume of fixative.
- If multiple tissues are fixed in the same container, swirl the container periodically and make sure tissues are not sticking together or floating.
- Fix for a MINIMUM of 24 hours; aim for 48 hours as a standard. A shaker or rocker will greatly assist in attaining even and complete fixation.
- Tissue must be transferred into 70% ethanol before submission. Please note the fluid type on the sample container for safe disposal.

Sample Drop Off

Orders are accepted Monday through Friday, 1:00pm-3:00pm, or by appointment.

- Sample submission form must be completed in its entirety prior to sample drop off. The form should be printed double sided.
- Bring sample and form to Sudro Room 134.
- Your submission will be given an order number at drop off. You will need to reference this number for questions and at pickup.
- The core will supply some supplies for submission; cassette, sponges, containers. Please contact the staff for more information.

Sample Return

User will be notified via email when orders are ready for pickup.

Orders may be picked up between 1:00pm-3:00pm, Monday through Friday, or by appointment in room Sudro 134.

PSCI 790: Graduate Seminar

Refer to the Syllabus document for more information and for the schedule of presentations.

Purpose:

The primary purpose of the weekly departmental seminar is to enhance your career development as a scientist and critical thinker. During seminar, you will have an opportunity to develop your communication skills, gain poise in presenting your work, exchange ideas, and to provide constructive feedback to your peers. You will also develop the ability to think on your feet in terms of asking and responding to questions. The skills learned in seminar will be needed throughout your career, whether presenting your work at a scientific conference, interviewing for a job, or teaching a class.

How-to:

Seminars are generally of two types: journal club and research seminar (where you will present your own work). You will be expected to present one seminar each semester while you are in the graduate program.

Begin by providing some rationale or context for your presentation. State the hypothesis to be tested or specific goal of the project. Next, describe the methods and research design of your study, followed by the results. Carefully and completely describe your figures, keeping in mind that the data and their interpretation should be the major focus of your seminar. Finally, briefly summarize your findings and conclusions. Always ask yourself: do the results justify the conclusions?

Be professional in presenting your seminar. When presenting a seminar, wear professional attire (business casual). Make eye contact with the audience and try not to read directly from your notes or slides. Speak slowly, distinctly and loud enough to be heard by everyone in attendance. Use the laser pointer judiciously; do not simply wave it around on the slide but, rather, point to the specific item(s) of interest. Keep the amount of text on your slides to a minimum; do not use lengthy, hard-to-read tables. Everything on your slides should be easily visible to those sitting in the last row at the back of the room.

Practice your presentation ahead of time. Seminars should last about 30 minutes. Your presentation should be about 20 min in length with 10 min remaining for questions and discussion. Please observe the time limit. Seminars that are unduly long or short indicate a lack of organization and will not be viewed favorably.

Expectations:

As a member of the audience, your participation is expected. Ask questions of the speaker or offer suggestions on how you might approach the problem or interpret the results. Remember, the purpose is to exchange ideas and to give the speaker feedback on his or her research.

Attendance at graduate seminars is required. In case an emergency comes up, please inform the faculty seminar coordinator, vagna.jarajapu@ndsu.edu. Department Office Staff at ndsu.psciofficestaff@ndsu.edu and Dr. Singh at jagdish.singh@ndsu.edu that you will be unable to attend. An unexcused absence (failure to attend seminar) will result in an unsatisfactory grade for the semester.

Audience members/graduate students are expected to provide an evaluation of student seminar presentations. Presenter-specific survey will be available on Blackboard. Evaluations will be completely anonymous and allow members of the department to provide constructive criticism and feedback.

General Cell Culture Regulations (Sudro 36)

1. Each user must undergo safety orientation prior to using the facilities.

2. The department will not provide common reagents. Supplies must be purchased from the P.I.'s own research funds.

3. Users may not store any cell culture reagents in the cell culture room.

4. Gloves (from your lab) must be worn to handle cells, flasks, etc. that pass into the hoods and incubators. Please remove gloves before exiting the cell culture rooms. At no time should gloves be worn in the kitchen, lunch area or offices.

5. Lab coats may be worn in the cell culture rooms, however, do not use lab coats that are used for animal experiments or bacterial culture, or stored in these areas. At no time should lab coats be worn in the kitchen, lunch area or offices.

6. **Do not use cell culture facilities for culturing bacteria.**

7. Do not store waste containers in the cell culture rooms. Please dispose of them at the end of each day in the biohazard bags.

8. Please tape up biohazard bags when they are 80% full and call (1-7759) to collect the waste. Similarly, the Biohazard liquid waste should be collected if any, and disposed via safety office.

9. Each user must obey the cell culture regulations, otherwise, they will be prohibited from using the core facilities.

10. Please clean the Biosafety cabinet after each usage (70% ethanol).

11. Please ensure that CO2 tanks have enough amount left, if found low please inform the department office.

12. If the water levels in the incubator is low, please add autoclaved water to keep the humidity.

Policies and Procedures for BD FACS Melody (Flow Cytometer) (Sudro 36)

- Equipment should be reserved through the Pharm Sci office
- Everyone must properly perform the startup, shutdown, and cleaning procedures as described in the training sessions. Initial training will be provided by Dr. Sijo Mathew (sijo.mathew@ndsu.edu) or Dr. Buddhadev Layek (buddhadev.layek@ndsu.edu)
- When planning a flow cytometry experiment it is important to make sure that samples must be filtered before analysis and no cell clumps present.
- **Every sample must be passed through the filter cap of a 5 mL polystyrene Round-Bottom 12x75mm tube with a Cell-strainer cap. (Recommended-Corning FALCON Ref-352235).**

- After removing the cap, load the samples in the sample holder in the **5 mL polystyrene Round-Bottom 12x75mm tube. (No other tubes should be used).**
- **Must use Cell staining buffer for sample preparation instead of PBS (BioLegend Cat. No. 420201).**
- If you are using blood samples, it is recommended to use **BD Phosflow Lyse/Fix Buffer. (BD Biosciences Cat. No. 558049).**
- The minimum sample volume recommended is 500uL (**Approximately 1 x 10^6 cells per mL).**
- Once the experiment is done, please make sure that the system is cleaned properly and SORT **NOZZLE is clean.**
- Please be aware that if we need to change the sample lane again (cost approximately $500) that may be charged to the user's PI's grant if it is due to the improper sample or usage of the instrument).
- All the PIs, are requested to kindly identify only one person (per lab) to use instruments and get trained properly (other members are expected to take help from this designated person during their experiments). **This will help us to avoid instrument downtime due to improper handling!**
- Please contact Sijo Mathew or Buddhadev Layek for trouble shooting.

General Olympus Confocal Microscopy Regulations - Sudro 103

1. Each user must undergo orientation/training prior to using the facilities. Even individuals with extensive experience outside of our department must receive an orientation. No individual may train another user in the use of the microscope.

2. Each user must reserve the confocal microscope. Individuals should send an email to ndsu.pscireservation@ndsu.edu to make a reservation.

3. Each user must sign up for microscopy time and must record the time used. Individuals not complying with these regulations will not be permitted to use the equipment.

4. All problems, breakages or other issues must be reported to Dr. Ang Guo (ang.guo@ndsu.edu) or Department Office Staff immediately in person, please use log book and document in the notes section as well. DO NOT leave unresolved problems for the next person to deal with.

5. The department will not provide common reagents. Supplies must be purchased from the P.I.'s own research funds.

6. Users may not store their own reagents in the microscopy room.

7. Users must use lens cleaning tissues to clean the microscope and other surrounding area by kimwipes (Important after each experiment/usage)

8. Each user must adhere to the confocal microscopy regulations or you will be prohibited from using the facilities.

9. Users are expected to save the acquired images to an external storage devices such as jump drive or memory stick. DO NOT leave the images on the hard disk. The hard disk will be cleaned **every week**.

10. Each user must enter the details of the use in the log book provided in the microscopy room, and provide comments/input after the experiment.

Instructions for Leica Fluorescence Microscope (Sudro 103)

- Each user must be trained by Dr. Ang Guo (ang.guo@ndsu.edu) prior to using the equipment.
- Even users with previous experience with fluorescence microscopy must have an orientation prior to use.
- Each user must reserve the microscope and record the usage and comments in the log book.
- Reservation link to reserve equipment: ndsu.pscireservation@ndsu.edu
- Files may be temporarily (less than 1 week) saved to the desktop under each lab at your own risk. All files should be exported and saved to an external drive. The computers will be cleaned every month to remove all the files.
- Only use USB ports in the front of the computer and NOT on the back must be used for importing files.
- Do not remove any USB drives from the computer.
- Report any issues to Dr. Ang Guo (ang.guo@ndsu.edu) or to one of the Department Office Staff in person or via email. DO NOT leave any unresolved issues at the end of your session.
- Users must have additional training to use the 40x and 63x oil immersion objective.
- The department will not provide any reagents nor should reagents be stored in the microscopy room.
- If you are using an oil immersion lens, the lenses should be cleaned thoroughly of oil after the use.
- Individuals not complying with these regulations will not be permitted to use the equipment.
- Area needs to be cleaned after every use. (Leaving your slides and tips on the table is a BIOSAFETY issue and it's not an acceptable practice)

Instructions for Zeiss Confocal Microscope - Sudro 102

- Each user must be trained by Dr. Ang Guo (ang.guo@ndsu.edu) prior to using the equipment.
- Please always carry a copy of instructions with you.
- Each user must reserve the confocal microscope. Individuals should send an email to ndsu.pscireservation@ndsu.edu
- Files may be temporarily (less than 1 week) saved to the desktop under each lab at your own risk. All files should be exported and saved to an external drive. The computers will be cleaned every month to remove all the files.
- Report any issues to Dr. Ang Guo (ang.guo@ndsu.edu) or to one of the Department Office Staff in person or via email. DO NOT leave any unresolved issues at the end of your session.
- The department will not provide any reagents nor should reagents be stored in the microscopy room.
- If you are using an oil immersion lens, the lenses should be cleaned thoroughly of oil after the use.
- Individuals not complying with these regulations will not be permitted to use the equipment.

Rules (Ultracentrifuge)

1. Every user needs to be trained by Dr. Layek, even users with previous experience with Ultracentrifuge must have an orientation prior to use. Always reserve the equipment if you plan to use. And always sign in the logbook.
2. Undergraduates are **NOT allowed** to operate this ultracentrifuge.
3. Always use Beckman certified **rotors** and matched **tubes**. Information is available at www.beckmancoulter.com/. Currently, we have four rotors: **sw41 Ti, SW55 Ti, SW32 Ti, TYPE 70 Ti.** These rotors have been tested and certified by Beckman engineer. **Only these rotors can be used on this Ultracentrifuge**. Rotors outside department of Pharmaceutical Sciences are not allowed.
4. Always double check the **proper filling** capacitance of tubes. Improper filling will cause severe imbalance and damage to the ultracentrifuge. You can find the information of tubes at www.beckmancoulter.com/.
5. Always check the **Chemical Resistance** of your tubes to your solvents at www.beckmancoulter.com/. Tube disruption during centrifuging will destroy the ultracentrifuge.
6. Use **analytical balance** to adjust the load. The samples must be **arranged symmetrically (paired) and balanced**. Odd number of samples is not allowed. Balance means: a. The weight difference between paired samples must be ≤ **0.001 gram**. b. The **density** of liquid samples must be the same. In another word, the solution composition of paired samples should be the same. c. The number on each swing bucket must match the position number on the rotor. d. The tubes must be filled properly. e. remove water droplets on the outside surface of tubes. **Check the Beckman instruction for tube filling before use.**
7. Always pay attention to abnormal noises during the acceleration phase. Don't leave until the setup speed is reached and stably maintained.
8. Your every single operation is monitored and logged. Every event (imbalance, et al) will be recorded by the system. The history of improper use will be tracked and reported regularly.
9. If you notice anything abnormal or violations, report to designated persons immediately. buddhadev.layek@ndsu.edu or one of the Department Office Staff.

I (print name)_____, as an user, have read and understood the rules and methods of using this ultracentrifuge. I will follow these rules and methods.

User Signature_____ date _____

Trained by _____ Trainer signature_____ date_____

Ultracentrifuge Rules and Users Guide

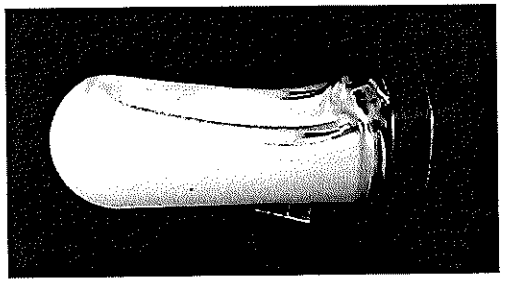
Rules

1. Every user needs to be trained by designated persons. Always reserve the equipment if you plan to use.
2. Undergraduates are **NOT allowed** to operate this ultracentrifuge.
3. Always use beckman certified **rotors** and matched **tubes**. Information is available at www.beckmancoulter.com/.
4. Always double check the proper filling capacitance of tubes.
5. Always check the **Chemical Resistance** of your tubes to your solvents
6. Use **analytical balance** to adjust the load. The samples must be **arranged symmetrically and balanced**.
7. **Always pay attention to abnormal noises during the acceleration phase. Don't leave until the speed is stable.**
8. **Your operations are monitored. Every event (imbalance, et al) will be recorded by the system. The history of improper use will be inspected and reported regularly.**

Balance means:

1. **The weight difference between paired samples must be < 0.001g.**
2. **The density of liquid samples must be the same.**
3. **The number on each swing bucket must match the position number on the rotor.**
4. **The tubes must be filled properly. Check the Beckman instruction for tube filling before use.**

Respect the centrifuge! Don't make these incidents happen!



Contact: Buddhadev Layek 701.231.6106 or
Department Office Staff 701.231.8902

Avoiding Plagiarism

Kristine J. Steffen, Pharm.D., Ph.D.
Professor/Pharmaceutical Sciences
School of Pharmacy
College of Health Professions
NORTH DAKOTA STATE UNIVERSITY

Resources

- Online tutorials
  - *http://www.lib.usm.edu/legacy/plag/whatisplag.php*
  - *https://www.indiana.edu/~istd/*
  - *https://plagiarism.duke.edu/*
  - *Several others*
- Resources
  - Blackboard → SafeAssign
  - Ithenticate → Department Assistant

NDSU Policies

- NDSU Resources/Policies
  - https://www.ndsu.edu/academichonesty/
  - NDSU Policy 335
    - https://www.ndsu.edu/fileadmin/policy/335.pdf

NDSU Policy 335

- Plagiarism (intentional or unintentional) constitutes academic misconduct at NDSU.
  - Plagiarizing – submitting work that is in part/whole not entirely one's own without giving credit to sources
- Penalties vary in severity according to the offense(s), up to and including suspension or expulsion from the University

What is Plagiarism?

- "**Plagiarism** is the act of taking another person's writing, conversation, song, or even idea and passing it off as your own."
- "This includes information from web pages, books, songs, television shows, email messages, interviews, articles, artworks or any other medium."
- "Whenever you paraphrase, summarize, or take words, phrases, or sentences from another person's work, it is necessary to indicate the source of the information *within your paper* using an **internal citation.**"
- "It is not enough to just list the source in a bibliography at the end of your paper. Failing to properly quote, cite or acknowledge someone else's words or ideas with an internal citation is **plagiarism.**"

University of Southern Mississippi Plagiarism Tutorial
http://www.lib.usm.edu/legacy/plag/whatisplag.php

You might be plagiarizing if you…

- Examples of Intentional Plagiarism
  - Purchasing a pre-written paper (either by mail or electronically).
  - Letting someone else write part or all of a paper for you.
  - Paying someone else to write part or all of a paper for you.
  - Submitting as your own someone else's unpublished work (including a computer program or algorithm), either with or without permission.
  - Submitting as your own, work done jointly by a group in which you may have participated.
  - Submitting work done by you, but for another class or another purpose without documenting that it was previously used.
  - Creating phony citations.

Duke Plagiarism Tutorial
https://plagiarism.duke.edu/intent/

You might be plagiarizing if you…

- Examples of Unintentional Plagiarism:
  - Failure to cite a source that is not common knowledge.
  - Failure to "quote" or block quote author's exact words, even if documented.
  - Failure to put a paraphrase in your own words, even if documented.
  - Failure to put a summary in your own words, even if documented.
  - Failure to be loyal to a source.

Duke Plagiarism Tutorial
https://plagiarism.duke.edu/intent/

Internal Citation

- "An **internal, in-text,** or **parenthetical citation** refers to the practice of giving credit to an author, singer, or speaker by citing their words/ideas within your paper."
- "This internal citation is then *referenced* at the end of your paper in your 'Works Cited' list."

University of Southern Mississippi Plagiarism Tutorial
http://www.lib.usm.edu/legacy/plag/whatisplag.php

Common Errors

- No quotation marks around specific language
  - Dropped quotations
  - Overuse of quotations
- Paraphrasing that retains the same language or sentence structure of reference
- Inaccurate or incomplete references

University of California, Davis
http://cai.ucdavis.edu/citation.html

Plagiarism Checking Software

- Ithenicate
  - See PSCI Department Assistant to use
- Blackboard
  - SafeAssign
- Recommend checking your work prior to publication or handing in writing assignments to class.

Working in the Animal Facility

Sudro 207

Animal Facility Personnel Contact Information

Shashi Bhushan, Ph.D.
COBRE Animal Laboratory Coordinator | Office: Sudro 222M
Contact No (Office / Cellphone) - (701) 231-1843 / (701) 729-3651 | Email: Shashi.bhushan@ndsu.edu

Camille Wienhold
COBRE Animal Laboratory Technician | Office: Sudro 222K
Contact N (Office) - 701-231-5650 | Email: Camille.m.jorgenson@ndsu.edu

**Please send an email or stop by one of our offices with any questions/concern/suggestion about the animal facility*

Gain Access to the Animal Facility

1. **Enroll in the Occupational health program for Individual who work with animals**
   A. A description of the program can be found here: https://www.ndsu.edu/fileadmin/policesafety/docs/OccupationalSafetyandEnvironmentalHealth.pdf. Please read this description and ask any questions you have to your PI, Jennifer Baker in the University Police and Safety Office, or Dr. Shashi Bhushan in the animal facility.
   B. Enroll in this program, the employee/researcher fills out a health assessment form that can be found here: https://www.ndsu.edu/fileadmin/vpfa/forms/UPSO-IACUC_HealthAssess.pdf. This form is private. Only the occupational health provider will review this form.
   C. PI/supervisor fills out a hazard and risk assessment form that can be found here: https://www.ndsu.edu//fileadmin/vpfa/forms/UPSO-IACUC_HazardRiskAssessment.pdf. Your supervisor must review and sign the hazard and risk form.
   D. When both forms have been completed, please contact Jennifer Baker to set up a short visit:

      Jennifer Baker
      Associate Director of Public Health & Safety | University Police & Safety Office NDSU
      Office Auxiliary Enterprise 106
      Email: jennifer.baker@ndsu.edu | Phone: (701) 231-6740

Jennifer will answer any questions you have regarding the Occupational Health program then she will mail the two forms into an occupational health provider.

In about a week the occupational health provider will send a message back to Jennifer, which she will then share with you, with any recommendations for you to work safely with animals. Jennifer will communicate your enrollment completion with the IACUC.

2. Complete all training required by the Compliance Committees.

There are 3 main Compliance committees, the Institutional Animal Care and Use Committee (IACUC), the Intuitional Biosafety committee (IBC), and the Institutional Review Board (IRB).

- IACUC oversees animal research at NDSU.
- IBC oversees the use of recombinant or synthetic nucleic acids, infectious agents, human blood, bodily fluids and tissue at NDSU.
- IRB oversees research involving human at NDSU.

A. The Administrators of the compliance committees will assign required training to a researcher when your PI requests that you be added to a protocol.
    a. This includes on-line training (CITI and NDSU University Police and Safety Office).
    b. IACUC requires in-person training. In-person training for mice may be completed with Dr. Shashi Bhushan and In-person training with Rats may be completed with NDSUs attending veterinarian.

B. Complete Animal Facility orientation.
    a. Animal facility orientation is a required walk through of the animal facility with Dr. Shashi Bhushan after you have enrolled in occupational health. This visit will be used to show the new individuals where everything is located in the Animal Facility, discuss applicable standard operation procedures (SOPs), show available resources, and to answer questions.

C. Complete IACUC required in-person mouse handling and husbandry training with Dr. Shashi Bhushan.

3. Obtain Card Access

Card access will be granted to individuals who have met all of the requirements of being approved by occupational health to work with animals, complete all compliance committee training, attend animal facility orientation, and pass required IACUC mouse handling and husbandry skills.

A. Being granted card access to this space is a privilege. Card swipes are logged and activity that occurs in these spaces is tracked.

B. Adherence to responsible use of card access is outlined in the following College and University Policies:
    a. College of Health Professions Policy 3.01, Student Academic and Conduct Standards:
    b. www.ndsu.edu/healthprofessions/college_information/policy_manual/
    c. https://www.ndsu.edu/fileadmin/policy/703.pdf
    d. https://www.ndsu.edu/fileadmin/policy/707.pdf

Rooms in the facility

A. Anteroom: Space where you gown up before entering the facility and gown down before leaving the facility.
B. Common area: space could be used to change cages.
C. Chambers: space where mice are housed.
D. Storage room: Space where food, bedding and enrichment are stored.
E. Mouse room: space where immunocompromised mice are housed.
F. Procedure room: space where surgeries and other procedures take place.
G. Clean room: space where clean cage components are stored.

a. Once items leave the clean room, they must go through proper sterilization process.

H. Dirty room: space where dirty cages are rinsed and processed for washing.

Equipment in the animal facility

Equipment in the animal facility is open to all individuals who have card access to the animal facility this equipment includes:

A. Vevo 3100 Ultrasound
B. Ami HTX imaging system
C. Biosafety cabinets
D. Isoflurane anesthesia equipment
E. Autoclave

- To be trained on equipment contact Dr. Shashi Bhushan, Shashi.bhushan@ndsu.edu.
- To reserve any equipment and/or space in the procedure room in the animal facility email ndsu.pscireservation@ndsu.edu. Use of the equipment and or space in the procedure room is first come first serve. In order to accommodate everyone ALL requests need to be written via email.

Safety requirements of ABSL-2 Facilities

The animal facility is an ABSL-2 facility which means animals may be infected with agents associated with human disease which poses a moderate hazard to you and the environment.

A. Proper attire for ABSL-2 facilities

- Long pants
- Close toed shoes
- Gloves
- Mask REQUIRED
- Shoe covers
- Animal specific Lab coat

- For special procedures other PPE may be required which will be provided to you by the animal facility or your PI.

There is a rack for your animal facility specific lab coat in the anteroom. Once you are granted access to the animal facility a specific hanger will be labeled with your name for you to store your lab coat in the animal facility. You are not allowed to wear a lab coat from your lab space into the animal facility, so if you are transporting samples into the facility, you must switch lab coats in the anteroom. You can temporarily store your other lab coat in a cubie in the anteroom. Additionally, your lab coat must be laundered every two weeks (we recommend the 1st and 3rd Monday of every month). In the event anything spills on your lab coat or if it appears dirty you must replace your lab coat sooner than two weeks. New lab coats can be found in Sudro 136 in the cabinets along the wall. Place dirty lab coat in the laundry receptacle located in the anteroom.

Waste Disposal in an ABSL-2 Laboratory space

Multiple types of waste are generated in the animal facility. The list below contains the waste disposal containers present in the animal facility. The list below each container consists of what can be placed in each container that you may encounter while working in the animal facility:

A. **Sharp bins**
   - Scalpels
   - Sutures
   - Syringes
   - Razor blades
   - Any other sharps that are contaminated with biohazardous materials, including recombinant or synthetic nucleic acids.

B. **Burn Up Bins**
   - All disposable personal protective equipment (PPE) goes in to burnup bins (gloves, mask shoe covers)
   - Anything that is not sharp and has blood on it goes into a burn up bin
   - Indicators
   - Pipet tips
   - ANYTHING THAT COMES IN CONTACT WITH BIOHAZARDOUS AGENTS

C. **Solid waste buckets**
   - Isoflurane bottles
   - Activated Charcoal

D. **Regular trash**
   - Anything that is not PPE, not a sharp, and has not come in contact with any biohazardous agents.

E. **Laundry bins**
   - Orange rags
   - Lab coats
   - Mop heads

F. **Freezer**
   - Place all animal carcasses and tissues into a red biohazard bag and put into the chest freezer in the animal facility.

Daily welfare check

1. Welfare must be performed daily (weekends & holidays) on all animals
   a. During daily welfare check for the following:
      - Signs of distress
      - Adequate water and food for 2+ days
      - Any injuries that have caused a break in the skin
      - Wet bedding
2. After daily welfare check sign the Activity log that corresponds to your lab and your PI. The activity log is the official document in which animal care is recorded. Recorded on this log is:

- Daily welfare check
- All animal husbandry activities
- Documentation of when issues with animals arise.

Cages

- A complete caging system consist of 6 parts, a bottom, a lid, a feeder, a water bottle, a sipper and a cage card. Each cage has a maximum capacity of 5 animals
    - The bottom is filled with ~ 2cm of bedding. Bedding serves many purposes for animals, it acts as a protector from the cold surface animal cages are placed on, animals play in the bedding, and use the bedding to nest.
    - The Lid protects the animals from dust in the environment.
    - The feeder holds both food and water for the animal.
    - The water bottle and sipper allow the animal access to water.
    - The cage card is a very important part of every cage, it states
        - Number of animals housed in a cage,
        - Strain of mice
        - Protocol number
        - Name of PI
        - Birth location (vendor, or NDSU-Animal facility)
        - Date of birth
        - Emergency contact

Cage changing

A. Every lab has a designated time where resources and space are available in the animal facility for cage changing. During this designated time your lab has priority to cage changing resources and common area space.
B. If uncontrollable events occur and you cannot change cages during you designated time, email Dr. Shashi Bhushan as soon as possible. We will work with you to find a new time for that week.
    a. Not changing cages during your designated time is a breach in protocol and only acceptable when uncontrollable events occur.
C. There are multiple steps in the cage changing process.
    a. Count how many cages you have.
    b. Gather all cage components from the clean room.
    c. Assemble all cages and place mice into their new home. While transferring mice from one cage to another, a thorough welfare inspection is done of each mouse.
    d. Wipe housing rack before placing a newly replaced cage.
    e. Processing of waste
        - Non-hazardous waste: dispose of all food waste and bedding waste in disposable station and properly dispose of waste in dumpster, located on the north side of Sudro Hall.
        - Hazardous waste: dispose of the waste according to your IBC protocol.
    f. All cage bottoms are rinsed and all dirty cage components are put on the dirty cart for further processing by Facility personnel.

g. Sweep floors of the chamber and space used

Controlled Substances

A. Review Pharmaceutical sciences DEA-controlled substances SOP.
B. Controlled substances must be locked at all times except when actively dispensing
C. All activity with controlled substances must be logged in the controlled substance binder designated for your lab
    a. This binder is checked Monthly and inconsistencies with the use of controlled substances will be followed up on by Dr. Shashi Bhushan.
D. When controlled substance are expired or need to be discarded, contact Dr. Shashi Bhushan. Do not discard any substances and any container (vial, Eppendorf tubes) used for controlled substances.
E. Mishandling of controlled substances is punishable by law in the United States so all personnel must be added to an authorized personnel list before being allowed to handle controlled substance.

Safety Reminder- Usage of Disposable Gloves

A. Disposable gloves are worn by users for protection against hazardous materials that may be encountered in the context of their work. Along with other personal protective equipment (PPE) they are important in protecting workers.
B. Just as it is critical to wear gloves inside the lab for protection, it is equally important to remove gloves before leaving the lab. The hazardous materials your gloves are protecting you from can be and are on your gloves. You do not want to transfer those materials to door handles, elevators buttons, telephones, water fountains, photocopiers, common equipment, etc. outside of the laboratory. People outside of the labs do not routinely wear PPE and will not be protected. It is important to remove your gloves even if you think or know they are not contaminated out of respect for others who might not know if you have handled hazardous materials with your gloved hand(s).
C. If you must transport something in between labs, one hand can remain gloved to hold the item, while you use your ungloved hand to open doors. An ideal situation is that you put the item on a cart for transport, then you do not need to wear gloves at all.
D. If it is helpful or facilitates personnel not wearing gloves between workspaces, gloves can be stocked in other rooms. Please voice these needs to your PI, or Dr. Shashi Bhushan.
E. Remember, whenever gloves are removed you should wash your hands. It is very difficult to remove gloves without getting what is on the outside of your gloves onto your skin somewhere.
F. If personnel are choosing to wear gloves outside the laboratory as protection against infection with SARS-CoV-2, I encourage you to instead utilize the hand sanitizer stations in the building, wash your hands frequently, and avoid touching your face. Gloves can become contaminated just as easily as hands and you may gain a false sense of security while wearing them.

Pharmaceutical Sciences DEA Controlled Substances SOP

I. Regulations

The Controlled Substances Act, Title II of the Comprehensive Drug Abuse Prevention and Control Act of 1970, regulates the manufacture and distribution of narcotics, stimulants, depressants, hallucinogens, anabolic steroids, and chemicals used in the production of controlled substances.

2.2 Code of Federal Regulations, 21CFR Parts 1300-1399; and 21 CFR Parts 1308 - Schedules of Controlled Substances.

2.4 Code of Federal Regulations, 40 CFR Parts 260, 261 and 264.

II. Schedule Definitions

In the Department of Pharmaceutical Sciences, we do not currently purchase or work with controlled substances in Schedules I or II. These substances have separate ordering, storage, and logging requirements that are not included in this manual.

Definition of Controlled Substance Schedules (from https://www.deadiversion.usdoj.gov/schedules/index.html; lists of controlled substances can be found at this website as well)

Drugs and other substances that are considered controlled substances under the Controlled Substances Act (CSA) are divided into five schedules. An updated and complete list of the schedules is published annually in **Title 21 Code of Federal Regulations (C.F.R.) §§ 1308.11 through 1308.15**. Substances are placed in their respective schedules based on whether they have a currently accepted medical use in treatment in the United States, their relative abuse potential, and likelihood of causing dependence when abused. Some examples of the drugs in each schedule are listed below.

Schedule I Controlled Substances

Substances in this schedule have no currently accepted medical use in the United States, a lack of accepted safety for use under medical supervision, and a high potential for abuse.

Some examples of substances listed in Schedule I are: heroin, lysergic acid diethylamide (LSD), marijuana (cannabis), peyote, methaqualone, and 3,4-methylenedioxymethamphetamine ("Ecstasy").

Schedule II/IIN Controlled Substances (2/2N)

Substances in this schedule have a high potential for abuse which may lead to severe psychological or physical dependence.

Examples of Schedule II narcotics include: hydromorphone (Dilaudid®), methadone (Dolophine®), meperidine (Demerol®), oxycodone (OxyContin®, Percocet®), and fentanyl

(Sublimaze®, Duragesic®). Other Schedule II narcotics include: morphine, opium, codeine, and hydrocodone.

Examples of Schedule IIN stimulants include: amphetamine (Dexedrine®, Adderall®), methamphetamine (Desoxyn®), and methylphenidate (Ritalin®).

Other Schedule II substances include: amobarbital, glutethimide, and **pentobarbital. **(Euthasol contains pentobarbital, but it is a Schedule III drug because it is mixed with other substances. Just be aware that if you order some other version of pentobarbital that it may be a Schedule II drug that has more stringent ordering, storage, and inventory requirements).**

Schedule III/IIIN Controlled Substances (3/3N)

Substances in this schedule have a potential for abuse less than substances in Schedules I or II and abuse may lead to moderate or low physical dependence or high psychological dependence.

Examples of Schedule III narcotics include: products containing not more than 90 milligrams of codeine per dosage unit (Tylenol with Codeine®), and buprenorphine (Suboxone®).

Examples of Schedule IIIN non-narcotics include: benzphetamine (Didrex®), phendimetrazine, ketamine, and anabolic steroids such as Depo®-Testosterone.

Schedule IV Controlled Substances

Substances in this schedule have a low potential for abuse relative to substances in Schedule III.

Examples of Schedule IV substances include: alprazolam (Xanax®), carisoprodol (Soma®), clonazepam (Klonopin®), clorazepate (Tranxene®), diazepam (Valium®), lorazepam (Ativan®), midazolam (Versed®), temazepam (Restoril®), and triazolam (Halcion®).

Schedule V Controlled Substances

Substances in this schedule have a low potential for abuse relative to substances listed in Schedule IV and consist primarily of preparations containing limited quantities of certain narcotics.

Examples of Schedule V substances include: cough preparations containing not more than 200 milligrams of codeine per 100 milliliters or per 100 grams (Robitussin AC®, Phenergan with Codeine®), and ezogabine.

III. Personnel Definitions

Researcher in the DEA registration application is authorized to use controlled substances and is responsible to understand and comply with all applicable rules and regulations by the Federal Drug Enforcement Agency (DEA) and the State of North Dakota for registration, purchase, use, and proper disposal of controlled substances in his/her research work. The Researcher retains all liabilities for loss, theft, or misuse of any controlled substance acquired through his/her registration. The use of controlled substances is approved for individual

researchers and only for the research location(s) described in their DEA application. Therefore, researchers must not distribute, transfer, or share the controlled substances to non-licensed researchers or other PIs. To do otherwise is considered a diversion of controlled substances and is against the DEA rules and regulations.

Authorized Laboratory Personnel are research staff, including graduate students and postdoctoral scholars, working under the direct supervision of a researcher. In addition to the researcher and authorized agents, the authorized laboratory personnel **(also known as daily users)** may participate in using controlled substances during experiments or treatments of research animals. Each licensed researcher is responsible for authorizing specific roles, and providing required training for proper handling of controlled substances.

The licensee/registrant holds ultimate responsibility for restricting access to the controlled substances. The licensee/registrant is required to keep an updated Authorized Personnel Log on file that lists the authorized agents and authorized personnel at a registered location.

IV. Ordering Procedure for Controlled Substances in Sudro

a. Controlled substances will be ordered by PSCI Office Staff. Fill out the Docusign form, "Request to Purchase" and select "PSCI Dept" on the drop-down screen. Once Sonja (business coordinator) approves the request, someone in the PSCI office will purchase item/s through Midwest Veterinary Supply, Inc., Lakeville, MN.
b. When controlled substances arrive, Office personnel in 136 will immediately notify Dr. Shashi Bhushan.
c. Dr. Shashi Bhushan will receive the drug, verify the order, sign and date the invoice, log the order, and properly secure the order.
d. Logging and properly securing the order may be done in conjunction with the end user who will be a documented Authorized Laboratory Personnel.

V. Storage Requirements

Upon acquisition, controlled substances must be stored in a securely locked, substantially constructed cabinet, located where access is limited to authorized individuals only. Our storage location is controlled by card access and individual keys.

The general security requirements are available at
https://www.deadiversion.usdoj.gov/21cfr/cfr/1301/1301_71.htm .

Controlled substances must be maintained behind a minimum of two (2) locks. The storage of the controlled substances can be within: (a) a locked cabinet in a locked room and the 'locked room' must always be locked when it is not occupied by either the registrant or an authorized user; or (b) a locked inner cabinet in a locked cabinet.

Locks may be cipher locks (combination locks) or key locks. If key locks are used, then (a) the two locks must be keyed differently; (b) two keys must not be stored together (i.e., not on the same key ring); (c) both keys must be safeguarded, and not in public sight; and (d) individuals with access to the keys must be approved by the licensed researcher.

Controlled substances must never be unattended at any time.

VI. Record Keeping

Record keeping must include **(templates included in the Appendix)**:

1. Records of receipt
    - The date the substance was received at the storage location
    - The substance name assigned by the manufacturer
    - The manufacturer of the substance or vendor
    - The quantity and strength of the substance added to the storage area
    - Name of individual adding product to the inventory

2. Records of use (including loss or theft)
    - Date used or disposal of waste
    - Quantity dispensed for aliquots, dilution
    - Strength dispensed (concentration and volume)
    - Name of person (authorized user)
    - Quantity remaining in inventory

3. Records of disposal of controlled substances
    - DEA Form 41 does not have to be submitted to DEA. Keep with Inventory.

4. Biennial Inventory: This Inventory will be performed by Dr. Shashi Bhushan and a witness. Please always have your General Inventories up to date as this will make the Biennial Inventory go smoothly.

5. Inventory and Inventory Audits: The licensed researcher must maintain a complete and accurate accounting of all controlled substances, from the time they are ordered until they are used up or disposed of. These inventories and records should be kept at the location where the licensed activity is conducted, and must be readily available for inspections. Chemical inventories of controlled substances must be perpetual and up-to-date. All records of inventories and logs of controlled substances shall be kept a minimum of two years and be available for inspections and copying by a member of DEA. The licensed researcher should maintain copies of the records documenting the transfer and disposal of controlled substances for a period of at least two years.

Labeling Containers: controlled substances that are removed from their original packaging and compounded, diluted or combined, must be labeled with a new control number, the final concentration, the amount per container and the expiration date.

VII. Disposal

The disposal of controlled substances is the final action necessary to ensure proper management of controlled substances.

Each licensed researcher is ultimately responsible to ensure controlled substances are properly disposed of and all necessary disposal forms are completed and submitted to the appropriate agency. A licensed researcher must dispose of outdated, damaged, or otherwise unusable or unwanted controlled substances. Please refer to NDSU SOP for destruction of controlled substances for this details related to this process (https://www.ndsu.edu/fileadmin/research/documents/IACUC/ndsu_guidelines/Pharmaceutical_Management.pdf).

Residual amounts of **non-recoverable** waste may remain in the used (empty) syringes or vials after the administration or use of a controlled substance. If this waste amount **cannot** be drawn out with a syringe (i.e., is non-recoverable), you may discard the empty controlled substance container in a biohazard sharps container. There is no need to record the disposal of the non-recoverable waste separately on the usage log if the container balance is zeroed out on the usage log upon disposal of that container. Biohazard sharps containers are collected by the Safety Office and incinerated.

If recoverable waste remains from container spillage (e.g., puddle on the bench top or floor):

1. Place cleanup refuse (e.g., paper towels or bench paper) from a spilled container into a secure biohazard or biohazard sharps container (both are collected by the Safety Office and incinerated).
2. Record spillage amount on the usage log **and** DEA Form 41 (Keep Form 41 in Inventory).

VIII. References

https://researcherhandbook.research.uiowa.edu/sites/researcherhandbook.research.uiowa.edu/files/CSGguide.pdf

https://www.deadiversion.usdoj.gov/index.html

http://research-compliance.umich.edu/controlled-substances/controlled-substance-research-policies

IX. Appendix – Logging Templates

Controlled Substance Research Records

General Inventory Log

Controlled Substance: **Schedule (II-V):**

Container Type: **Container Size:** **Concentration:**

DEA Registrant name: Dr. Jagdish Singh

DEA Registrant Address (as appears on DEA Certificate of Registration):

1401 Albrecht Blvd., Sudro Hall 207A1B, Fargo, ND 58108-6050

***Container ID # is assigned by lab upon drug receipt**

Date	Amount Received	*Container ID #	Amount Dispensed	Container Balance	Authorized Personnel Dispensing	Comments (Received from supplier, transferred to multi-dose or dilution log, or sent for disposal)

Controlled Substance Research Records

Multiple Dose Usage Log

Controlled Substance: ____________________ **Schedule (II-V):** ____________________

Container Type: ____________________ **Container Size:** ____________________ **Concentration:** ____________________

Lot # ____________________ **Expiration:** ____________________

Beyond Use Date: ____________________ **Container ID #:**____________________

DEA Registrant name: ____________________

DEA Registrant Address (as appears on DEA Certificate of Registration): ____________________

1401 Albrecht Blvd., Sudro Hall 207A1B, Fargo, ND 58108-6050

***Container ID # is assigned by lab upon drug receipt**

Date	Number of Animals	Amount Withdrawn	Balance	Authorized Personnel Dispensing	Amount Wasted	Witness Initials	Amount Disposed (ml)	Comments (waste details)

Controlled Substance Research Records

Diluted Solution Usage Log

Controlled Substance: **Schedule (II-V):** ***Container ID #**

Container Type: **Container Size:** **Concentration:**

Lot # **Expiration:**

Volume or Weight Used for Dilution:

Diluent solution and volume: **Final ratio/ concentration:**

Beyond Use Date:

DEA Registrant name: Dr. Jagdish Singh

DEA Registrant Address (as appears on DEA Certificate of Registration):

1401 Albrecht Blvd., Sudro Hall 207A1B, Fargo, ND 58108-6050

***Container ID# is assigned by lab upon drug receipt**

***Dilution ID# is assigned by lab when dilution is mixed**

Date	Number of Animals	Amount Withdrawn	Balance	Authorized Personnel Dispensing	Amount Wasted	Witness Initials	Amount Disposed (ml)	Comments (waste details)

Authorized Personnel Log Instructions

Each licensee/registrant or research laboratory must keep an updated copy of this form at all times. This includes any status changes of employees (job responsibilities, new hires, vacated positions). Only individuals listed shall be granted approval to work with controlled substances. State and DEA Diversion Investigators expect the registrant to have an updated copy on file to review during inspections.

Grant Authorized Agent status to a minimum number of staff to mitigate risk of drug diversion. Authorized agents are designated by the licensee/registrant to oversee drug ordering, receiving, distribution to authorized personnel for research use, witnessing of drug waste, and maintaining access to the safe or locked cabinet.

Authorized personnel may work with controlled substances as part of their research experiments, but only the licensee/registrant or their authorized agent(s) may distribute controlled substances.

Authorized Personnel Log

Department: Pharmaceutical Sciences

Name/Address as listed on DEA Certificate of Registration: Dr. Jagdish Singh, 1401 Albrecht Blvd., Sudro Hall 207A1B, Fargo, ND 58108-6050

DEA Registration #_____

Name (Last, First)	Job Title	NDSU ID#	Signature	Access Granted Date	Access Removed Date

How to get Added to an IACUC Protocol

1. Enroll in the University's Occupational Health Program.
    a. The guidelines that explain NDSU's Occupational Health Program can be found here: https://www.ndsu.edu/fileadmin/policesafety/docs/OccupationalSafetyandEnvironmentalHealth.pdf. You should read these Guidelines to familiarize yourself with the program.
    b. The person to be added to the protocol (new Graduate Student/Post Doc/Faculty or Staff Member) fills out the "Health Assessment for Persons Working on Animal Projects" form, which can be found here: https://www.ndsu.edu/fileadmin/vpfa/forms/UPSO-IACUC_HealthAssess.pdf
    c. The Supervisor of that person fills out the "Hazard and Risk Assessment" form, which can be found here: https://www.ndsu.edu//fileadmin/vpfa/forms/UPSO-IACUC_HazardRiskAssessment.pdf
    d. Once the Hazard and Risk Assessment as well as Health Assessment Forms are ready, the enrollee should call or email to set an appointment with:

        Jennifer Baker Quenette
        Associate Director Public Health and Safety NDSU
        Phone (701) 231-6740 | | E-mail: jennifer.quenette@ndsu.edu
        Fax (701) 231-6739

    e. Bring your two forms with you to the appointment with Jennifer. At the appointment, Jennifer will answer any questions you have regarding the Occupational Health Program and she will mail your forms for you to an Occupational Health Provider.
    f. The Occupational Health Provider will review your information and determine if there are any recommendations needed for you to safely do your work with animals. The Provider will send the results of their review to Jennifer who will then email you the results and notify the IACUC that you have enrolled in the program. This process takes approximately 7-10 days.
    g. Enrollment is a one-time event **unless** you: 1) have changes in your health status, or 2) your hazards and risks associated with your work change. If either of these scenarios occur, then you should fill out new enrollment forms and re-submit them to be reviewed by a Provider again following the steps listed above. If you have any questions regarding the Occupational Health program at any time you should contact Jennifer to discuss them.
    h. If you have previously enrolled in the Occupational Health Program at NDSU (i.e. you worked on another animal project on campus and were previously on another IACUC protocol) you should come talk to Dr. Shashi Bhushan and we can discuss if you may need to re-enroll, and how to do it.
2. Complete online IACUC training (you can do/begin this while your enrollment in the Occupational Health Program is pending).
    a. The IACUC requires online training through CITI, which you can find instructions for completing here: https://www.ndsu.edu/research/for_researchers/research_integrity_and_compliance/institutional_animal_care_and_use_committee_iacuc/training/

i. If you have questions about CITI training, please contact the IACUC Administrator:

Tania Molden
Rm 132, Research 1 | NDSU Research & Technology Park
701.231.8114 | tania.molden@ndsu.edu | ndsu.iacuc@ndsu.edu

b. You will also need to complete the NDSU Safety Office training module entitled "Animal Care and Use Training" found here (scroll down just a bit, under the heading "Annual Position Dependent and Other Requirements"):
https://www.ndsu.edu/police_safety/annual_notices_and_training/

i. If you have questions about this training, you can contact Jennifer Baker Quenette (please see contact information above in the Occupational Health Program section above).

3. Complete in-person training. In-person training can be scheduled any time **after enrollment in the Occupational Health Program is complete**. We want to make sure it is safe for you to work with animals before we conduct in-person training.
   a. The IACUC requires in-person training (or if you have previous animal experience, documentation of skills) before you can be added to a protocol.
   b. Please contact Dr. Shashi Bhushan to set up in-person training when your Occupational Health Program enrollment and IACUC online training are completed (Shashi.bhushan@ndsu.edu; 231-1843; office 222M). You will attend animal facility orientation first then hand-on training. The standard information covered during orientation includes an overview of the facility operational guidelines, available resources, and animal husbandry. The in-person training includes mouse handling and restraint/ husbandry. Other skills and techniques can/will be covered if necessary for the protocol. Training can be updated in the future on an as-needed basis when new skills are added.
   c. People requiring training to be added to rat protocols should ask the IACUC for recommendations to complete in-person training (Tania Molden's contact information is in the Online Training section above). These investigators should still complete a Facility tour and orientation with Dr. Shashi Bhushan before beginning their work, but this can occur any time after occupational health enrollment has been completed. Please contact him when you are ready to complete this portion of your training (Shashi.bhushan@ndsu.edu; 231-1843; office 222M).
4. After steps 1-3 have been completed, the IACUC is usually pretty good about notifying Dr. Shashi Bhushan when people from Pharmaceutical Sciences are added to protocols, but please let him know for sure when this process is complete. He will make sure you have a lab coat, name tag, and can help to get card access to 207 (if applicable).

Sudro Animal Facility Card Access Guidelines

Purpose: The purpose of these guidelines is to delineate who may work in the Sudro Animal Facility, what types of privileges are granted to different groups of workers, and to define the requirements for being granted the ability to work in the Animal Facility.

I. Defining Access to the Animal Facility

a. Pharmaceutical Sciences Faculty members, post-docs, research scientists, paid visiting scholars, graduate students (including graduate students admitted under the Cellular and Molecular Biology Interdisciplinary Program and are solely mentored by a Pharmaceutical Sciences Faculty member), and laboratory technicians.
   i. After meeting all requirements, this category of personnel will be granted full, 24/7 access. They may work in the Animal Facility unsupervised.

b. COBRE Faculty members, post-docs, research scientists, paid visiting scholars, graduate students (including graduate students admitted under the Cellular and Molecular Biology Interdisciplinary Program and are solely mentored by a COBRE Faculty member), and laboratory technicians.
   i. After meeting all requirements, this category of personnel will be granted full, restricted hours access. They may work in the Animal Facility unsupervised.

c. NDSU faculty members and/or graduate students, post-docs, paid visiting scholars, and laboratory personnel who are collaborating with Pharmaceutical Sciences or COBRE Faculty members.
   i. After meeting all requirements, this category of personnel will be granted supervised access. These researchers will not have their own card access. At all times, they can only work in the Animal Facility together with another researcher who does have full access, and who is supervising the work.

d. Graduate Students whose primary department is other than Pharmaceutical Sciences, but are co-mentored by Pharmaceutical Sciences faculty.
   i. After meeting all requirements, this category of personnel will be granted supervised access, upon approval of the Animal Facility Director. These researchers will not have their own card access. At all times, they can only work in the Animal Facility together with another researcher who does have full access, and who is supervising the work.

e. Professional students (PharmD students in their P3 or P4 year) who would like to perform research with Pharmaceutical Sciences faculty.
   i. After meeting all requirements, this category of personnel will be granted supervised access. These researchers will not have their own card access. At all times, they can only work in the Animal Facility together with another researcher who does have full access, and who is supervising the work.

f. Undergraduates who work in Pharmaceutical Sciences or COBRE laboratories.
   i. After meeting all requirements, this category of personnel will be granted supervised access, upon approval of the Animal Facility Director. These researchers will not have their own card access. At all times, they can only work in the Animal Facility together with another researcher who does have full access, and who is supervising the work.

g. Undergraduates who work in other Departments (collaborators).
    i. These individuals will not be given permission to work in the Animal Facility. They may not work in the Animal Facility supervised, or unsupervised.
h. Children (under age 18) who participate in high school programs (for example, Governor's School).
    i. These individuals will not be given permission to work in the Animal Facility. They may not work in the Animal Facility supervised, or unsupervised.

II. Requirements that must be met before working in the Animal Facility

a. Enrollment in the Occupational Health Program for people who work with animals
    i. A description of the program can be found here: https://www.ndsu.edu/fileadmin/policesafety/docs/OccupationalSafetyandEnvironmentalHealth.pdf. You are encouraged to read this description and ask any questions you have to your PI, Jennifer Baker in the University Police and Safety Office, or Dr. Shashi Bhushan.
    ii. In order to enroll in this program, the employee/researcher fills out a health assessment form that can be found here: https://www.ndsu.edu/fileadmin/vpfa/forms/UPSO-IACUC_HealthAssess.pdf. This form is private. Only the occupational health provider will review this form.
    iii. The PI/supervisor/employer fills out a hazard and risk assessment form that can be found here: https://www.ndsu.edu//fileadmin/vpfa/forms/UPSO-IACUC_HazardRiskAssessment.pdf. It is OK for the researcher and the supervisor to work together to fill out this form; however, the supervisor must review and sign the hazard and risk form.
    iv. When both forms have been completed, please contact and set up a short visit to:

Jennifer Baker
Associate Director of Public Health & Safety | University Police & Safety Office
jennifer.baker@ndsu.edu | **Phone:** (701) 231-6740
Office Auxiliary Enterprise 106

Jennifer will answer any questions you have regarding the Occupational Health program then she will mail the two forms into an occupational health provider.

    v. In about a week the occupational health provider will send a message back to Jennifer, which she will then share with you, with any recommendations for you to work safely with animals. Jennifer will communicate your enrollment completion with the IACUC.

b. Complete all training required by the Compliance Committees.
    i. Depending on the protocol(s) associated with a project, this will include requirements by the IACUC and may also include requirements by the Institutional Biosafety Committee and/or the Institutional Review Board. The Administrators of the compliance committees will assign required training to a researcher when a PI requests that they be added to a protocol.

ii. This includes on-line training (CITI and NDSU University Police and Safety Office). The IACUC also requires in-person training. The in-person training for mice may currently be completed with Dr. Shashi Bhushan.

c. Complete a walk-through/orientation of the Animal Facility.
   i. This is a one-time requirement when a worker is new to the Animal Facility. This visit will be used to show the new worker where everything is located in the Animal Facility, discuss applicable SOPs, give instructions on equipment operation, and to answer questions.
   ii. This orientation may be combined with IACUC in-person training, which is required to be added to an IACUC protocol.
   iii. Please arrange for this orientation (and in-person training if needed) once enrollment in the Occupational Health Program has been completed.

III. Card Access

a. Card access will be granted to individuals who are in qualified groups and who have met all of the requirements of working in the Animal Facility.
b. Upon approval by the Department, the Key Control Official for the building will process required paperwork to grant access to the Animal Facility, and to the building.
c. Dr. Shashi Bhushan will verify with PSCI office staff that the individual has met all requirements as outlined in section II of this SOP.
d. Dr. Shashi Bhushan will send the names and ID numbers of individuals to Dr. Singh Chair, PSCI) and Lori Witt (Operations Manager, Deans Office, Health & Human Sci), who will then forward them to the Key Control Official.
e. Being granted card access to this space is a privilege. Card swipes are logged and activity that occurs in these spaces can and will be traced back to whomever swiped their card to enter at a specific time if the need arises.
f. Cards are not to be loaned to another individual to enter these spaces. Card access is granted to individuals, not ID cards. Individuals will be held responsible for whatever happens in a space when their card is used.
g. Adherence to responsible use of card access is outlined in the following College and University Policies:
   i. College of Health Professions Policy 3.01, Student Academic and Conduct Standards, www.ndsu.edu/healthprofessions/college_information/policy_manual/
   ii. https://www.ndsu.edu/fileadmin/policy/703.pdf
   iii. https://www.ndsu.edu/fileadmin/policy/707.pdf

SOP for Facility Emergencies Impacting Sudro 207

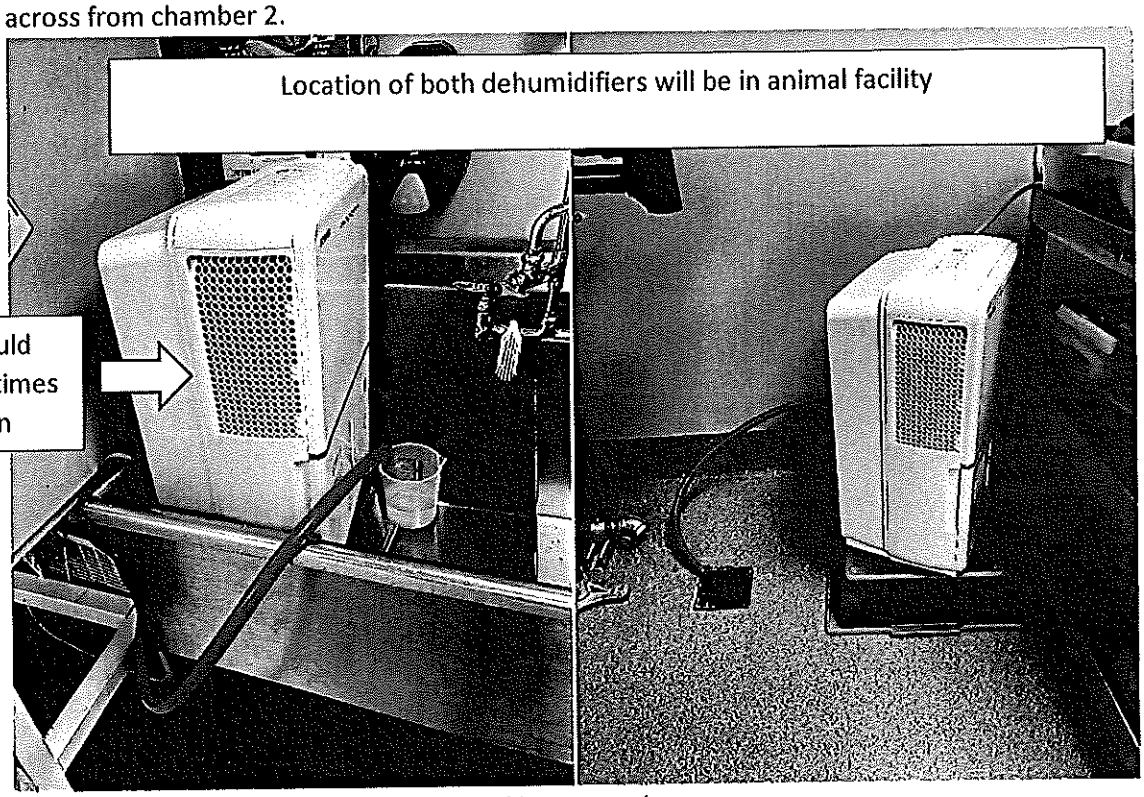
1. Alarm notifications generated from Johnson Controls are programmed to go to the following people as of 2/4/20 (all at once, not sequentially):
    a. Dr. Jagdish Singh (701-261-3180)
    b. Dr. Shashi Bhushan (701-729-3651)
2. Alarm notifications during normal working hours will be called in to Facilities Management for repair with the necessary immediacy dependent on the type of repair needed:
    a. Number for Facilities Management: 231-7911
    b. Number for Cory Hanson (HVAC): 231-6678/701-866-1742
    c. Number for Kyle Kraft (Electrical): 231-9330/701-793-9917
    d. Number for Craig Gast (Locksmith): 231-7302/701-936-0521
3. In the event of an after-hours alarm notification:
    a. Notified staff member(s) shall come to Sudro to inspect the Facility and gather information on the situation. Person (or persons) traveling to Sudro will text others on the notification list to let them know they are performing this task.
    b. Once more information is known (RE: temperature in space(s); HVAC alarm/is down; power status, etc.), call is placed to NDSU Police (231-8998). NDSU Police will notify Facilities Management staff on call if necessary.
        i. It is possible that Facilities Management will be notified before a notified staff member gets to Sudro since temperature alarms are also sent to the University Police who notifies Facilities Management. They may already be in Sudro 207 when you arrive, or they may call Dr. Shashi Bhushan before coming to 207. Both have occurred. The on-call Facilities Management personnel have the ability to contact other members of Facilities Management if/when necessary and they also have additional information regarding issues that may be impacting campus (i.e. They have access to online Johnson Controls' information and they communicate with off campus entities such as the power company).
        ii. **If power is out in building, card access readers to building and Sudro 207 are still supposed to work for up to 36 hours.**
    c. A follow-up text message will be sent to members of the notification list with an update on status of animal holding rooms, what action is being taken, and if additional help is needed.
    d. As soon as reasonable, PSCI office staffs will be notified of the Facility emergency. Staffs can assist with Departmental notifications, and other coordination with Facilities Management personnel.
4. In the event that chambers housing animals cannot provide adequate housing conditions (i.e. sufficient temperature, ventilation, lighting), animals will be cared for in the following way:

SOP if Animal Facility is too hot

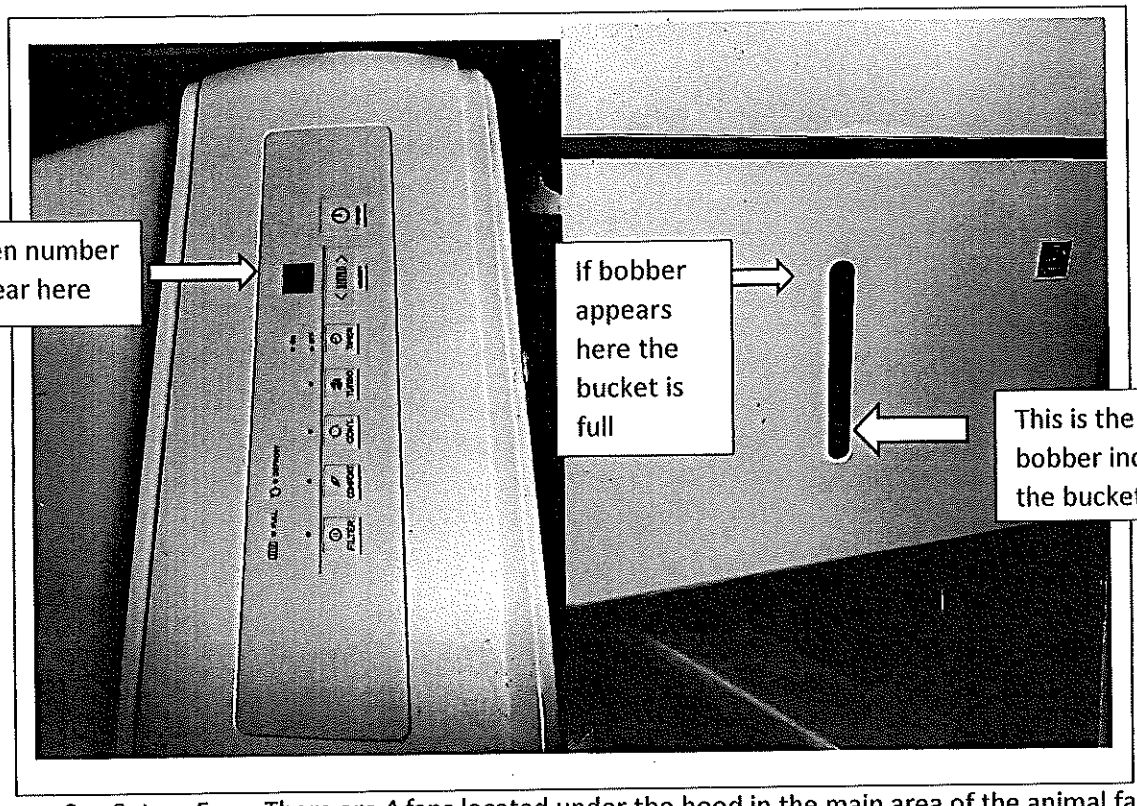
Appropriate Temperature range is: Between 65-75 F

Appropriate Humidity range is: Between 40-60%

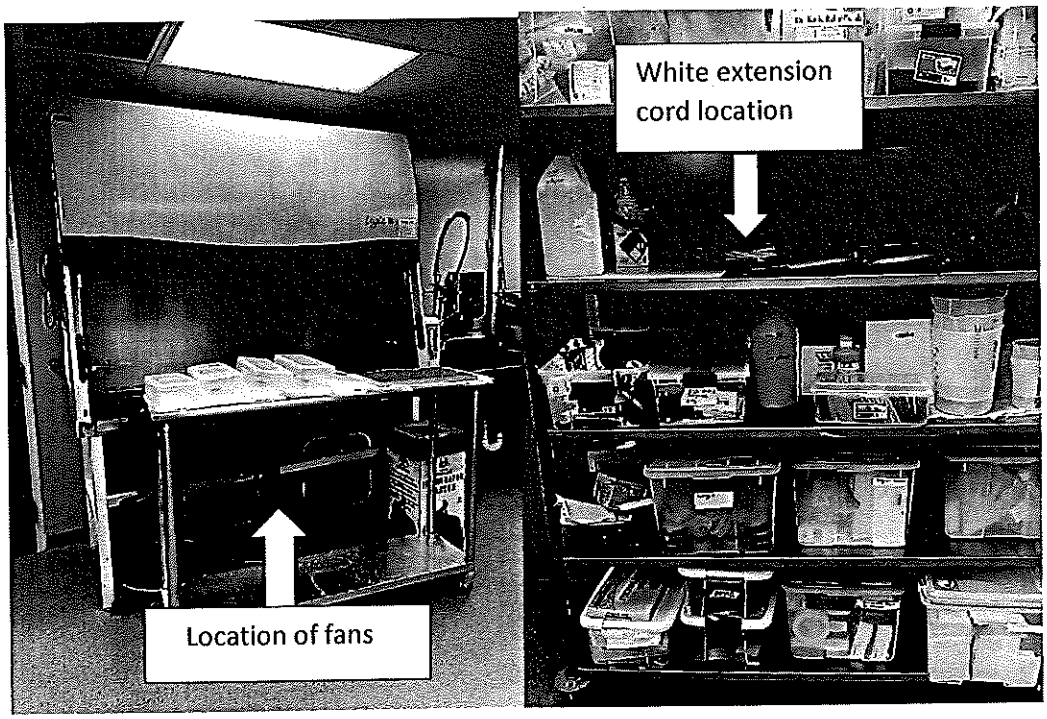
1. Two dehumidifiers will be placed in the animal facility. One will be located by the clean room under the contamination shower. The second dehumidifier will be located in the large sink across from chamber 2.



   a. How to know dehumidifier is working properly
      i. Air should be blowing out of each side vent
         1. If not check:
            a. If power button has been turned off
            b. If outlet needs to be reset (you can reset outlet by pushing in the buttons that are between each plug in)
            c. Check if the water collection bucket at the bottom of the dehumidifier- IF full the red bobber will indicate as seen in the image below
               i. if full pull on each side handle located on the bottom of the dehumidifier to release the bucket and pour out all of the bucket's containments and replace bucket by pushing it into the bottom of the dehumidifier.
            d. Check if the green hose is still attached to the back of the dehumidifier. Make sure hose is not kinked and is leading to a drain.



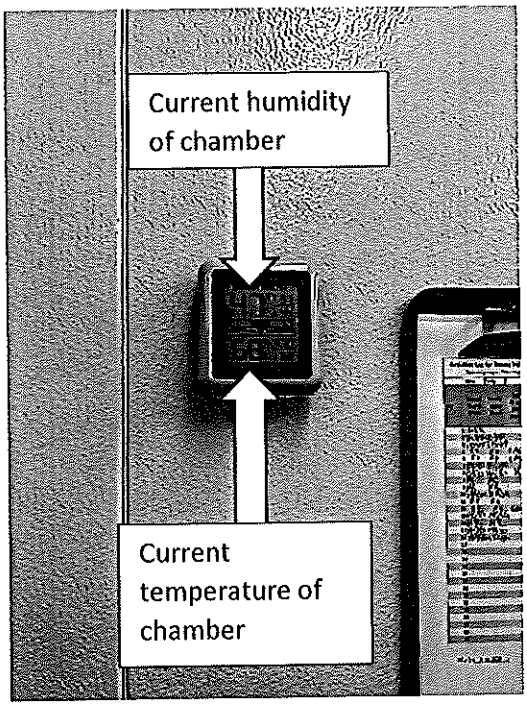
2. Set up Fans. There are 4 fans located under the hood in the main area of the animal facility.
    a. Place fans all over the animal facility and turn them on high.
        i. If needed there are extension cords on the rack outside of the mouse room



3. Contact Facilities management

a. NDSU number – 1-7911

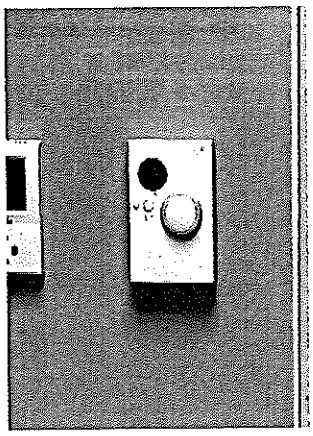
4. Contact Cori Hanson from HVACK. HVACK is responsible for monitoring all temperatures and humidifies for the animal facility
    a. Office number – 1-6678
    b. Cell phone number- 701-866-1742
5. Have a designated person to check on the Rat room.
6. IF A CHAMBER OR CHAMBERS ARE NOT FUNCTIONING
    a. Each chamber has a temperature and humidity monitor on the wall as seen in the image below.
    b. If temperature in the chamber is extreme:
        i. Chamber doors may be left propped open to allow for air circulation from the fans.
        ii. animals can be moved into the procedure room/common area (Check common room thermostats prior to moving animals to a new space)



Appropriate Temperature range is: Between 65-75 F

Appropriate Humidity range is: Between 40-60%

PREFROM WELFARE CHECK ON ALL ANIMALS



FYI there are additional thermostats as seen above on the walls in the common areas.

If high temperature is sustained or power goes down for extended period of time

a. Individually ventilated cage (IVC) racks with mice may also be temporarily relocated into the space just outside of the chambers after rats have been moved if conditions are more stable in this space.
b. The Allentown IVC Racks hold cages that default to static housing if power is lost. Mice on these racks will lose their source of HEPA filtered inlet and exhaust air and appropriate negative pressure containment (if in place) would be lost; however, these mice are not in danger of hypoxia in the event of a power outage.
c. If mice are housed on the Innovive rack in dual filtered Innorack lids they have 6 hours before they are in danger of becoming hypoxic due to loss of rack supported inlet air. The options are:
    i. Generator support for the Innovive IVC Rack.
    ii. Switching the lids on these cages out for static housing lids to allow for appropriate gas exchange from room air.
        1. Performing lid exchange outside of a biosafety cabinet may present an unacceptable exposure to mice and/or personnel.

5. In the unlikely event that power or HVAC cannot be restored in a time deemed reasonable to restore livable conditions for mice and/or rats, then we will proceed with humane euthanasia of the animals.
    i. Before we move forward with this option, all efforts to involve the IACUC and/or the Attending Veterinarian will be made to discuss the situation and alternatives.
    ii. Methods available for euthanasia are CO_2 (requires power), isoflurane overdose (power independent), and/or Euthasol (power independent). Secondary methods of euthanasia will be employed to ensure death that are consistent with species, age of the animal, and skill/training of personnel.
6. If steps 5 or 6 must be employed, contact of laboratory personnel will commence immediately by one or more of the notified personnel. Contact information on the Chamber doors will be used to notify personnel from the labs with impacted animals. Judgement will be used as to the number of laboratory personnel that need to be called in for assistance. More personnel from

the Department and/or campus may be needed if many animals need to be moved, if animals need to be moved out of Sudro, or if animals are going to be euthanized.

Department of Pharmaceutical Sciences
Guidelines

Ordering Procedures

The first step is to fill out a Request to Order sheet.
file:///C:/Users/diana.kowalski/OneDrive%20-%20North%20Dakota%20University%20System/Desktop/Fillable%20Order%20form.pdf

Please type your request (do not hand write) with the following information: vendor name, vendor phone, quantity, unit (please indicate case, pack, or each), catalog number, brief description of the product(s) you want ordered, price, funding information, requestor's name, date requested, and faculty approval. There will be a line that says, "Other Details" please add Promo Codes, Quote #'s, Delivery option, etc. on this line. No orders will be placed if the faculty does not sign off on the order sheet.

If your information on top is not filled out completely your order will not be processed and will be sent back to you to correct this information.

PO# line should be left blank – Business Center will assign the order a PO#

Order Reference# should be left blank – this is where we put the order# once the order has been placed with the vendor.

*****For any equipment orders over $10,000, fill out an order sheet and give it to Sonja Hunter (Business Coordinator). Anything not ordered from VWR or Fisher needs to have an Alternative Procurement Request Attached*****

Sequencing Orders

When ordering from IDT or any other company for sequencing, please fill out the Docusign "Request to Order" form and the Business Center will assign a PO# for you to use. Wait for the approval from the Business Center before ordering any sequencing. Select "self" on the drop-down section of the Docusign – you must order your own sequencing. Once you get the email confirmation for your sequencing, please bring a copy of the confirmation email along with the Docusign "Request to Purchase" approval form to the PSCI office.

Request to Order
Department of Pharmaceutical Sciences
1401 Albrecht Blvd., Sudro Hall Room 136, Fargo, ND 58105-5716

Vendor Name:
Vendor Phone: **Internet Address:**
Vendor Address: **Room # for Airgas:**
PO#: **Order Reference#**

Qty	Units (Cs, Pk)	Catalog #	Brief Description	Unit Price	Total Price

Other details, if necessary (Promo codes, quote numbers):

Order Total:

Funding Info & Approval

Project #: (i.e. FAR0011234):
Other Funding Info:
Requester's Name:
Date Requested:
Approved By:

The next step is to fill out the Docusign, "Request to Purchase" form.
https://www.ndsu.edu/healthhumansciences/people/accounting_college_forms/

Request to Purchase: Purchase request for supplies (office supplies including software, research supplies); events (internal and/or external catering, event supplies, brochures); memberships and subscriptions; Print & Copy (brochures, business cards, paper, signs); Bookstore purchases; In-State travel (motorpool, registration/conference fee prior to travel); Out-of-State (airfare, registration/conference fee prior to travel). At the drop-down menu, select how purchase will be made (Accounting Portfolio 3, Self, Department P-Card, PSCI Dept).

Request to Purchase

This is what it will look like once you click on "Request to Purchase" form. (Students: if you are the one sending in the order to Docusign, you will type your name and email. (exp. John Smith, PSCI, Dept. 2665 and then your email address.

Next you will fill in your PI's information (name and email) Once these are filled out, click on "Begin Signing."

PowerForm Signer Information

Fill in the name and email for each signing role listed below. Signers will receive an email inviting them to sign this document. **REQUEST FOR PURCHASE - COLLEGE OF HHS**

Please enter your name and email to begin the signing process.

Requestor Name / Department Name / Dept #

Your Name:

Your Email:

Please provide information for any other signers needed for this document.

Department Chair/Designee (REQUIRED)

Name:

Email:

Carbon Copy (1) (OPTIONAL)

Name:

Email:

Next you will fill this page out. On the "Requestor" line, please type in your name/PSCI/Company name. On the Department Name/Number line type in PSCI/2665 and make sure you upload your "order form" along with any Quotes you may have. Under the comments, you can type "please see attached order form and Quote". On the next few lines, you can type in the items you want ordered (catalog # along with a short description) so the Business Center can see how much each item costs before approving your request. If you are ordering from Amazon, you must select the Accounting Dept. on the drop-down screen as to "Who will make the Purchase." It is helpful if you include the Amazon links on your "order form" so there's no confusion as to what they are supposed to order. Once you are done filling this out, please double check that your order form was attached before clicking on "Finish." Shipping address is 1401 Albrecht Blvd., Sudro 123, Fargo, ND 58105

NDSU COLLEGE OF HEALTH AND HUMAN SCIENCES

Request to Purchase

Please turn this form in 5 business days before the purchase is made.
Receipts must be turned in to hhsbusinesscenter@ndsu.edu within 2 weeks of the event, or purchase.
If the purchase is over $10,000, please work with your department's Business Coordinator.

Details:

Requestor: _____ Today's Date: _____

Who will make the Purchase(s): -- select -- Needed by: _____

Department Name/Number: _____

Optional

Comments & Purpose (attach document for additional comments and/or items):

Qty	Units (Cs, Pk)	Vendor	Brief Description	Unit Price	Total Price

Shipping Address: _____

Order Total: 0.00

Funding source(s) to be used: _____

Departmental Approval: _____ **Business Center Approval:** _____

Finish

Quotes: No Quotes will be ordered without the correct shipping and billing address on the quote. Make sure when you ask for the Sales Rep to repeat the shipping and billing address that it's correct. (Our correct shipping and billing address is located at the end of this booklet). Please do not use your lab/office number on the quote for the address.

After your order arrives, remove the packing slip and check to make sure you have received every item that is listed on it. Keep the packing slip in your lab for 1 year. If you receive an item/s that is NOT yours, please bring it up to the office immediately so we can check to see who it belongs to. All deliveries will be delivered to Sudro 123 (Dean's Office) for you to pick up. Someone in the Dean's Office will notify your lab that you have a package. If picking up a package after hours, (7:30-4:00, M-F, Summer/breaks and 8:00-5:00 during the academic year) please remember to bring your ID with you so you can get back to our side of the building.

When the invoice arrives, it will be matched with the Docusign order form. The order form along with the Invoice will be placed in a folder and placed in the PI's mailbox for their initials indicating that they have received item/s on the Invoice, please use pen and NOT PENCIL to initial the invoices. The PI will give it back to the office staff and the process will start in paying the Invoices that we receive.

Docusign link for forms to use for purchases and reimbursements

https://www.ndsu.edu/healthhumansciences/people/accounting_college_forms/

Accounting/College Forms

Request to Purchase: Purchase request for supplies (office supplies including software, research supplies); events (internal and/or external catering, event supplies, brochures); memberships and subscriptions; Print & Copy (brochures, business cards, paper, signs); Bookstore purchases; In-State travel (motorpool, registration/conference fee prior to travel); Out-of-State (airfare, registration/conference fee prior to travel). At the drop-down menu, select how purchase will be made (Accounting Portfolio 3, Self, or Department P-Card or PSCI Dept).

Request to Purchase

Design & Sign Order Form: Form used for Design & Sign projects. Submit form to **ndsu.designandsign@ndsu.edu** or Memorial Union. Submit a copy of the form along with receipt after project has been completed via Request to Pay Invoice.

Design & Sign Order Form

Travel Authorization – Out-of-State: Travel request prior to making travel arrangements (form required by the Accounting Office). An approved form is required for travel reimbursement (i.e. airfare, registration, lodging, per-diem, misc. travel expenses). A copy will be retained by the HHS Business Center once the form has been approved by all signees.

OOS Travel Authorization

Travel-Purchase Reimbursement Request: Reimbursement request for travel and/or purchase made (i.e. office supplies, items for an event, airfare and/or registration prior to or after travel). This form includes the Travel Expense Reimbursement form required by the Accounting Office.

Travel-Purchase Reimbursement Request

Individual Purchases

Fill out the Docusign, "Request to Purchase" form and wait for approval before going to the store to purchase any items. Supplies that cannot be ordered through the department can be purchased locally or online. In order to be reimbursed after making the purchase, fill out the **Docusign,** "Travel-Purchase Reimbursement Request" form and submit for payment.

If the purchase is made with a credit card, please include:

- Copy of store receipt (with the last 4 digits of your cc number listed)
- A photocopy of your credit card showing your name and only the last 4 digits of your credit card. Please cover up the beginning part of your credit card number before making the copy. Keep a copy of this so that next time you get reimbursed for something you have it on hand. We will not keep a copy of your credit card so you will have to send this along with all of the other receipts when asking for a reimbursement.
- **Using someone else's credit card when buying supplies is not allowed.**

Bookstore Purchases

Faculty and staff can charge to the department with prior approval. Fill out the **Docusign** form, "Request to Purchase" form and submit it, the HHS Business Coordinator for Pharmaceutical Sciences will process the request. Once you get the approval, you can go to the bookstore and make your purchase.
(**no charging below $5.00)

Airgas Orders

An order sheet needs to be filled out including funding and a signature from the PI. Include this form with your Docusign, "Request to Purchase" form. If it's urgent, please type in under "comments" that you need the tank/s filled ASAP. Only "department office staff" can order from Airgas. Please provide:

- the product you want ordered
- number of tanks you are ordering
- how many tanks you are returning
- what room number the tank/s are in

Liquid Nitrogen:

The only tank that Airgas will replace is the big Liquid Nitrogen tank in Sudro 36. Each lab is responsible for refilling their own small tank. There is a logbook for you to fill out when refilling your small tanks. Please include date, name and an estimate of how much liquid nitrogen you used.

When the tank is empty, please let Benjamin Tagoe (1-7233) (Dr. Singh's Lab – Sudro 107) or David Gyamfi (1-8896) (Dr. Jarajapu's Lab) and Ben or David will let the office staff know that it's empty so that we can call Airgas and order more. Orders for the Liquid Nitrogen must be placed by Noon on Thursday for the following Tuesday delivery.

PSCI faculty that are using the Liquid Nitrogen are on a rotating basis on which PI is paying for the refill. (The common tank is the one on wheels and isn't hooked up to any piece of equipment)

Animal Facility

If doors to the animal individual rooms are not sealing properly and you notice an increased odor, contact Dr. Shashi Bhushan (1-1843) shashi.bhushan@ndsu.edu or Camille Weinhold at camille.weinhold@ndsu.edu or one of the department office staff right away.

Laundering of Lab Coats

Each Tuesday, Shashi/Camille will bring down the dirty lab coats from the animal facility to the area outside of Sudro 103. Make sure all dirty lab coats from the animal facility are in the bag before Tuesday.

Any dirty lab coats from your lab should be placed in the laundry bin by Tuesday also.

Once Cintas picks up the dirty lab coats, and the canvas bag is empty, please put in a clear plastic bag (located just to the right of this bag) BEFORE putting in the first dirty lab coat.

Common Cell Culture Incubator—Sudro 36

Recommended that the water be changed every **three weeks**. Those using the incubator should share this responsibility. We need to have a healthy cell culture practice and save the students the horror of ruining one another's experiments. Please use the log book to document when you change the water.

Common Equipment Reservation List

Reservations for the Animal Facility are reserved thru Shashi

Equipment	Location	Trains/Maintains
Biosafety Cabinet (outside of 207)	Sudro 207 (big hood)	Shashi 1-1843
Biosafety Cabinet (nude mice-caged)	Sudro 207A1C	Shashi 1-1843
Ultrasound/Procedure Room	Sudro 207A1B	Shashi 1-1843
Procedure Room (Surgical)	Sudro 207A1B	Shashi 1-1843
Isoflurane	Sudro 207A1B	Shashi 1-1843

Reservations for the Common Equipment are reserved thru the ndsu.pscireservation@ndsu.edu email

Equipment	Location	Trains/Maintains
CD Machine	Sudro 36	Dr. Vetter 1- 5281
Zeiss Confocal Microscope	Sudro 102	Dr. Guo 1-5164
Olympus Confocal (old)	Sudro 103	Dr. Guo 1-5164
Developer (Dark Room)	Sudro 6A	Saber 1-5169
Leica Fluorescence Microscope	Sudro 103	Dr. Guo 1-5164
Lyophilizer - Freeze Dryer	Sudro 9	Dr. Vetter 1-5281
Microplate Reader (PSCI students only)	Sudro 36	Drs. Leclerc/Vetter 1-5564
Ultracentrifuge (Avanti Centrifuge)	Sudro 36	Dr. Layek 1-7906
Zetasizer (DLS particle)	Sudro 36	Karl 1-7877
Flow Cytometer	Sudro 36	Dr. Mathew 1-8214
Incubator	Sudro 36	
Biosafety Cabinet	Sudro 36	
Water System	Sudro 9	David 1-8896 or Ben 1-7233

Developer (Dark Room)

Make sure you reserve the developer thru the ndsu.pscireservation@ndsu.edu link. Directions on how to use the machine are on the wall. **When you are done processing, please leave the cover open and shut it off. Clean up after yourself; wipe or mop up all spills.**

Do not use half sheet films, doing this will jam the processor. If there are any issues or questions concerning the developer, please contact Saber in Dr. Guo's Lab – Sudro 11, 1-5169.

Maintenance is done every 3 to 4 months on the equipment. If you know that we are running low on supplies, please let one of the department office staff know and they will have RTI bring them when they come to service the machine.

Log Sheets

When using the common equipment, make sure you fill in the log sheet with your name, date, time used, etc. If the log book sheets are full, please let one of the department office staff know so new sheets can be added.

Water System

Water system is located in Sudro 9, if you have any questions/concerns with this system please contact David (1-8896) or Benjamin (1-7233). Please let one of the department office staff know as well if there are any issues.

Paper Towels (brown multi-fold) for individual labs (Central Stores)

If your lab needs brown paper towels, please fill out an order sheet with funding and signature from your supervisor, attach this form to the Docusign "Request to Purchase" form. Once this is approved by Business Center, it will be ordered thru Central Stores. Try not to wait until you only have one pack of paper towels left. The cost is approximately $16/case.

Online Training (Faculty, Staff and Students)

Beginning August 1, 2025, the training requirements are as follows:

New Employees

- All new employees are required to complete in-person (including Zoom) Equal Opportunity/Title IX training within 60 days of their employment start date.

Current Employees

- All employees must complete NDSU's Equal Opportunity/Title IX training annually in *Vector Solutions*. This training will be assigned under *My Assignments*. Please note that other similar trainings will **not** fulfill this requirement. (This training will be available starting August 1, 2025.)
- In addition, all employees are required to complete separate in-person (including Zoom) training tailored to their unit, department, or college at regular intervals (approximately every three years). Units will receive communication about scheduling.

Supervisors

- The *Supervisor Supplement: Equal Opportunity/Title IX Training* is no longer required and will not be offered at this time.

Who Is Considered an Employee?

"Employee" includes, but is not limited to:

- Part-time student employees
- Part-time staff and faculty (including adjunct and academic positions)

- Graduate Assistants, Graduate Teaching Assistants, Graduate Research Assistants (any graduate student on a tuition waiver)
- Full-time staff and faculty
- Resident Assistants

Please feel free to contact me with any questions or concerns.

Respectfully,

Heather

Heather Higgins-Dochtermann
Director, Equal Opportunity and Title IX Compliance
Safe Zone Ally - Pronouns *she/her/hers*
Office of the Vice Provost for Student Affairs and Institutional Equity
NORTH DAKOTA STATE UNIVERSITY

Online Lab Safety Training Courses (this page is updated every August)

The Safety Office provides a wide variety of Laboratory Safety Training Courses. This page provides information on training requirements, course offerings, and enrollment.

What Online Laboratory Safety Training Courses are Required?

Students, staff and other personnel working in laboratory spaces must complete any training relevant to their work and/or the hazards of the lab or that is assigned by their department.

Principal investigators and lab supervisors must complete the same trainings assigned to those working in their lab in addition to *Laboratory Safety Training for Principal Investigators.*

How Often is Training Required?

Most Online Laboratory Safety Training Courses are required to be completed annually and are valid for the fiscal year (July 1st – June 30th). Online Waste Handling Refresher Training is required every semester.

How Do I Complete Online Laboratory Safety Trainings?

1. Log into Vector Solutions using your Bison Login and Password.
2. Navigate to 'My Assignments' to view and complete any obligated courses.
3. If you need to complete additional courses that are not listed in "My Assignments," then navigate to "Extra Training," and either search for a specific course (be sure to have the correct course name), or navigate to the "Policy" tile where most of NDSU training courses are.

What Laboratory Safety Training Courses are Offered Online?

Laboratory Safety Training: This course contains information about general laboratory safety and how to identify hazards in the lab. It includes information on fire and electrical hazards and helps prepare for emergency situations.

Vector Solutions Course Name: *Laboratory Safety Training FY26 (Policy Tile)*

Waste Handling Online Refresher - This course contains information on proper waste handling and is required each semester for all employees that generate hazardous

waste. IMPORTANT: IN-PERSON Initial Waste Handling Training must be completed BEFORE enrolling in the Online Refresher (scroll down for more information).

Vector Solutions Course Name: *Waste Handling Online Refresher Training (current semester date) (Policy Tile)*

Radiation Safety Training: This course contains basic radiation safety information. Additional training requirements must be met if an employee will be actively working with radioactive material.

Vector Solutions Course Name: *Radiation Safety Training FY26 (Policy Tile)*

Biosafety and Bloodborne Pathogens Training: This course contains basic information on biohazards and biosafety awareness for those working in laboratories with infectious substances and/or bloodborne pathogens. Additional training requirements must also be met as part of a research team under approval of the Institutional Biosafety Committee. See links elsewhere on the "Recommended for all Employees" tab under "Training" to the left for CITI Biosafety Training.

Vector Solutions Course Name: *Biosafety and Bloodborne Pathogens Training FY26 (Policy Tile)*

Nanomaterial Safety Training: This course contains basic information on nanoscale materials and the unique safety issues associated with working with these materials. It forms a foundation that can be built upon through additional laboratory specific training.

Vector Solutions Course Name: *Nanomaterial Safety Training FY26 (Policy Tile)*

Laboratory Safety Training for Principal Investigators: This course is designed to familiarize the Principal Investigator or Laboratory Supervisor with additional requirements and responsibilities associated with their role.

Vector Solutions Course Name: *Laboratory Safety Training for Principal Investigators FY26 (Policy Tile)*

Initial Waste Handling Training (In-Person)

In-Person training required by any employee who might generate hazardous waste or supervise someone generating hazardous waste.

What is Initial Waste Handling Training?

Initial Waste Handling Training is an IN-PERSON course and is only required one time during your NDSU career.

Initial Waste Handling Training contains information on proper waste handling and disposal of many types of regulated wastes on campus.

Who is Required to Complete Initial Waste Handling Training?

Initial Waste Handling Training is required for anyone that may generate or handle regulated wastes AND for anyone that supervises personnel generating or handling regulated wastes.

All employees who use hazardous chemicals in a laboratory, greenhouse, or field site should complete Initial Waste Handling Training.

When Is Initial Waste Handling Training Offered?

A number of in-person training sessions will be offered throughout the semester. If you would like us to provide Initial Waste Handling Training in a departmental group setting, please contact the Safety Office at 701-231-7759 to arrange.

When attending in person at the Memorial Union please bring a lap top with if you are able so you may complete the online quiz.

Thursday, July 10, 2025 9:00 a.m. - 11:00 a.m. Meadow Lark, Memorial Union

Tuesday, August 26th 1:00 p.m. – 3:00 p.m. Meadow Lark, Memorial Union

Wednesday, September 3rd 9:00 a.m. – 11:00 a.m. Meadow Lark, Memorial

All employees who use hazardous chemicals in a laboratory, greenhouse, or field site must complete this initial in-person waste handling training. Online refresher training is required each semester an employee is working in lab thereafter.

Please see Chemical Hygiene Plan and policy 166.1 concerning institutional laboratory and chemical safety or contact the Safety Office 701-231-7759 if you have questions.

North Dakota State University
Phone: (701) 231-8998 / Fax: (701) 231-6334
Campus address: University Police and Safety 102
Physical/delivery address: 1523 12th Avenue North, Fargo, ND 58102
Mailing address: NDSU Dept. 3300 / PO Box 6050 / Fargo, ND 58108-6050

Computer and Printer Orders

All computer and printer orders can now be placed by individual faculty but you can't pay for it with your personal credit card or any other payment, see note below. HP and Mac computers are supported on campus. Specs can be found on the HP or Mac websites but all orders must be placed through the NDSU Bookstore or work with Sonja Hunter (Business Center) 1-5919 for approval. Please fill out an order sheet with the funding that you want to use and then fill out a Docusign, "Request to Purchase" form and submit the form for Sonja/Dept. 2665 to approve the funding.

Subject: Reminder on Computer Purchases

When purchasing computers, personal credit cards **cannot** be used. NDSU will **not** reimburse personal purchases for these NDSU resources. Instead, other methods should be used in order to avoid sales tax, increase internal controls and transparency. In addition, by purchasing through the IT department, support will be able to be provided by Desktop support. Options include:

Ordering through ITS
(https://www.ndsu.edu/its/help_desk/desktop_support_hub/hardware/preferred_hardware/)
Contact the NDSU Bookstore
Direct bill from vendor
Purchasing card

Reimbursement requests received will no longer be approved by Accounting. If you have any questions and concerns, please contact the Accounting office.

Thanks,
Travis Aho
Accounting Manager | Finance & Administration
NORTH DAKOTA STATE UNIVERSITY
P: 701.231.5661 | E: travis.aho.1@ndsu.edu

Software

Software needs approval before anything can be ordered or downloaded. An email needs to be sent to Melissa Eslinger (Melissa.Eslinger@ndsu.edu), CC Sonja Hunter (Sonja.hunter@ndsu.edu) and then Melissa will work with the university to get the software approved. Once approved, Melissa will send an email to the person requesting the software. Once you receive approval from Melissa, fill out an order form and the Docusign, "Request to Purchase" form along with the approval from Melissa. Once approved by the Business Center it will be ordered.

Software: https://kb.ndsu.edu/it/99782

NDSU Licensed Software

NDSU licenses a variety of programs for use at no charge by faculty staff and students. These include anti-virus and anti-spam software, networking and utility software.

Overview

Software Downloads for Students, Faculty and Staff

NDSU licenses a variety of programs at no charge for use by faculty staff and students. These include anti-virus and anti-spam software, networking and utility software.

Log in at the Software Downloads page to access these programs.

Software for NDSU-Owned Computers

NDSU provides software for university-owned computers through the Software Licensing program in Information Technology Services. See the list of Software Licensing Contacts to find out who is responsible for ordering software in your department or business unit. Please contact this person first regarding any software requests. **You will need to login with your NDUS credentials to view the list. Please notify ndsu.software.licensing for any changes to your department**

Additional information, including pricing, is available on Software - Faculty and Staff Price List page.

Information regarding purchasing Apple software for NDSU-owned computers is available on the Apple Software page.

Software in Computer Labs and Classrooms

A variety of software programs are installed in computer labs and instrumented classrooms. To request installation of software in computer labs and instrumented classrooms, work with your department software contact to submit the request form. **You will need to login with your NDUS credentials to view the list. Please notify ndsu.software.licensing for any changes to your department**

Other Software Or Platforms

If you are looking for Third Party software or services that are not included above, complete the software review form. This process will require review by NDSU IT Security staff. Depending on cost, it may also need review by the ND Assistant Attorney General.

Help, consultation, training

Training

Software Contact Training Document

Software

Email: **ndsu.software.licensing@ndsu.edu**

IT Service Center

- **ndsu.itservice@ndsu.edu**
- Phone **(701) 231-8685**
- **Submit a Ticket**

Intended Audience

- Faculty
- Staff
- Students

Using this solution

Availability

24/7/365 [*Standard outages]

Cost

Software - Faculty and Staff Price List

Related resources

- NDSU-Owned Computer Software Order Form
- Software - Contacts - **You will need to login with your NDUS credentials to view the list. Please notify ndsu.software.licensing for any changes to your department**
- Software - Faculty and Staff Price List
- Software and Online Services - Security and License Review
- Software Available in Classrooms and Computer Labs
- Classroom and Lab Software Installation Request
- Licensed Software Installation Instructions

Printing of Posters at Design & Sign Printing and Promotional Services

Poster printing services will be printed by Design and Sign, on the main level of the Memorial Union. When you know you will be going to a conference, and you will be presenting a poster, have your PI fill out the Design and Sign form (example on next page) with their signature/date and what funding is to be used ahead of time.

Fill out the Docusign, "Request to Purchase" form. Allow at least 5 working days for the Business Center to approve your request. You need to get the approval from the Business Center first. Make sure you upload your filled out Design & Sign form. You can hold on to that form/approval until you actually need to have your poster printed. Don't wait until the last minute to get everything approved. Most posters cost around $48.

When the time comes to have your poster printed, go to the Docusign page and click on this link:

Design & Sign Order Form: Form used for Design & Sign projects. Submit form to ndsu.designandsign@ndsu.edu or go to the Memorial Union in person to get your poster printed. Submit a copy of the form along with receipt after project has been completed via Request to Pay Invoice.

Request to Pay Invoice: Request to pay an invoice received from a vendor/supplier; order form along with receipt of purchase from on-campus vendors (Print & Copy, Design & Sign, etc.); approved Contracted Service Agreement (do not include W-9).

Pay Invoice Request

DESIGN & SIGN
PRINTING AND PROMOTIONAL SERVICES

ORDER INFORMATION

for INTER-DEPARTMENTAL BILLING

we cannot begin your order until this is complete

701.231.7573 ndsu.designandsign@ndsu.edu ndsu.edu/mu/design_and_sign

CUSTOMER INFORMATION

Project Name:

*Customer Name:

*Contact Info (email or phone):

DEPARTMENT BILLING INFORMATION

*Department #:

*Fund #:

Project # (Optional):

Program # (Optional):

*Department Name **(no acronyms)**:

*Building Name and Room # (to send the IDB):

PROJECT DESCRIPTION

Tell us about your project - size, quantity, paper type, etc.

* **Required**
- Please allow a 24 hour turn around for printing orders and 2-4 days or more for projects that require design

DESIGN & SIGN

Receipt/Invoice

Project Id 20967
Project Name ATS poster
Department Pharmaceutical Sciences
Address
Contact
Date 05-18-2018

NDSU Design & Sign
Phone - (701) 231.7573
email - ndsu.designandsign@ndsu.edu
web - ndsu.edu/mu/design_and_sign

ID	Resource	PRICE	QTY	TOTAL
1210	Graphics Plot 42 Glossy (1 foot)	$9.00	4.6	$41.40
			GRAND TOTAL	$41.40

Payment Method:	Charge
Department/AR#:	2665
Fund:	4600
Project:	FAR0027001
Other1:	n/a
Other2:	n/a

Print Name: _____

Signature: _____ Date: ____/____/____

By signing, you are agreeing to payment as well as accepting the project AS-IS. Please be advised that we cannot guarantee color matching, mounting is not permanent, and moisture will damage prints. We will not be held responsible for errors in customer supplied materials or for mistakes in spelling, punctuation, sentence structure, or file errors as submitted or proofed by the customer.

For additional information, including details on ordering timelines and processes, costs, and expanded payment options, visit https://www.ndsu.edu/mu/design_and_sign/ . Please call 701.231.7573 if you have questions.

Travel Reimbursement Guidelines

Please fill out the Docusign, "Travel-Purchase Request" form along with all of your receipts.

Travel-Purchase Reimbursement Request: Reimbursement request for travel and/or purchase made (office supplies, items for an event, airfare and/or registration prior to or after travel). This form includes the Travel Expense Reimbursement form required by the Accounting Office.

Travel-Purchase Reimbursement Request

Guideline for Travel and Reimbursements -

1. **HHS College -Request to Purchase/Travel Form -**

With this request there are two options:

- **Select ACCOUNTING** - NDSU Accounting Service Center will help to purchase flights and Registration with their PCard. The ASC will reach out to you and work directly with you once approved. (ASC is pretty quick and flexible to work with they . This can be done in person or remotely) NDSU ASC is fluent/follow NDSU/OMG Polices for travel.

- **Select SELF** – Once approved you may purchase yourself and then complete and attach all receipts with the Trave-Purchase Reimbursement Request Form (this way has multiple steps and reimbursement could take 7-15 business days) It is your responsibility to read through and abide by NDSU/OMB Policies for travel.

If travel is for employee – NDSU Accounting - Travel Authorization Part 1 (Travel Request) needs to be completed

If travel is for student – NDSU Accounting - Travel – Student Payment (needs to be completed by student's advisor/supervisor)

2. **HHS College - Request for Trave-Purchase Reimbursement Request Form** – once travel is completed you will complete and submit this form for any reimbursements you would like. You will need to attach any documentation such as receipts or maps or justification for expense.

Contact HHS Business Center or NDSU Accounting Service Center with any questions.

BELOW ARE THE LINKS YOU CAN USE:

College HHS Forms - Accounting Office Forms | College of Health and Human Sciences | NDSU

College HHS Business Center & Account Service Center Website - College of Health & Human Sciences | Accounting Office | NDSU

NDSU Accounting Travel Website - Travel | Accounting Office | NDSU
North Dakota OMB - Fiscal Policies and Guidelines | Office of Management and Budget North Dakota

Please include the following information when submitting travel receipts:

- Were any meals included with the registration cost?
- Registration printout with the prices of the different categories of registration fees.
- Copy of the homepage of the conference you will be attending.
- Copy of the Conference Agenda.
- Provide the confirmation flight information receipt (not itinerary) from the Airlines or whichever service you use. (Orbitz, Expedia, etc.) This should include Ticket #, Departure/Arrival times, etc. (Credit card statements with these charges on them will NOT work)

Hotel/Airfare and any other expenses made during a travel period must be purchased by **each individual person. Please do not charge other people's expenses on your credit card.**

Loss damage waiver is not an allowable expense when renting a vehicle.

Safe fees that hotels charge is not an allowable expense – **ask the hotel to remove the fees before they print out your itemized receipt**- if they will not remove the fees, whether you use the safe or not, you will not be reimbursed.

Travel Authorization Form is needed two weeks prior to out of state travel and one month prior to foreign country travel.

Faculty are to have department chair's approval
Students are to have their supervisor's approval – they must also fill out the, "Travel Expense Reimbursement Request" and the "Payment for Student Travel" forms before attending any conferences.

https://www.ndsu.edu/fileadmin/vpfa/forms/ACCT-TravelExpenseCoverSheet.pdf

https://www.ndsu.edu/sites/default/files/fileadmin/vpfa/forms/ACCT-PayStudentTravel.pdf

Meal Reimbursement

You have the option of getting reimbursed for meals by PER DIEM or by handing in itemized receipts. (students need to ask their supervisor how they will be reimbursed before they leave concerning their meals.

Per Diem Reimbursements

- When handing in Per Diem reimbursement information thru the ndsu.psciorders@ndsu.edu email link, please include whether you are getting reimbursed for Breakfast, Lunch, Dinner or if any of these meals were included with the registration cost. (need a copy of the conference agenda)

- The State of ND only allows a certain amount for breakfast, lunch and dinner and the amount changes depending on your location. (Breakfast = $9.00 Lunch = $14.00 Dinner = $22.00)

Itemized Meal Reimbursements

- All meal receipts **must be itemized** and included with your reimbursement request thru the Docusign, "Travel-Purchase Reimbursement Request", for reimbursement along with any other expenses that you want to be reimbursed for. Any expense without an itemized receipt will **NOT** be reimbursed. (Credit card statements with these charges on them will **NOT** work.

UBER/TAXI/Lyft

- Receipts must be the receipts from the drivers. (Credit card statements with these charges on them will **NOT** work. All tips must be included in the original receipts. There is a $5.00 maximum tip you can give someone. If you want to give them more, you must pay them in cash and not get reimbursed. Please write on these receipts where you were picked up and where you were dropped off. (Example: Airport to Hotel, Hotel to Conference Center, etc.) A map must also be included with each receipt.

Faculty Membership Dues Renewal

Fill out the Docusign, "Request to Purchase" form and submit for approval.

Information needed when sending in your Docusign, "Request to Purchase" form:

- Renewal notice from organization with your name on it
- Member ID#
- Letter explaining why this membership will benefit you and NDSU

Once approved, use your personal credit card and pay for your renewal. After you get confirmation that you paid your renewal, please fill out the Docusign, "Travel-Purchase Reimbursement Request" form.

Information needed when sending in your Docusign, "Travel-Purchase Reimbursement Request" form:

- Copy of the confirmation/receipt of payment.
- Copy of your credit card used (before copying your credit card, please cover your card number except for the last 4 digits)

Other Information:

- Membership fees must be paid out of your other funds – you can't use your grant money to pay for memberships
- You can only pay for a 1- year membership at a time
- **Please do not wait until December to renew your membership dues if they are due by January.**

Preliminary Defense Procedures

1. Check Graduate School website for preliminary defense requirements.
2. Check with department office staff on Dr. Singh's availability and room availability.
3. Check with committee members on their availability
4. After selecting a date and time, please confirm room reservation with the department office staff.
5. Preliminary defense must be sent to your committee members **two weeks prior** to presentation. If it is not, you will not be allowed to present and will have to reschedule.

Final Defense Procedures

1. Check Graduate School website for final defense requirements.
2. Check with department office staff on Dr. Singh's availability and room availability.
3. Check with committee members on their availability.
4. After selecting a date and time, please confirm room reservation with someone in the PSCI office.
5. Final defense must be sent to your committee members **two weeks prior** to presentation. If it is not, you will not be allowed to present and will have to reschedule.

Registering for PSCI 899

When registering for classes, please contact Jean Trautmann at 1-7589, Sudro 118A (jean.trautmann@ndsu.edu)

In the summer, PSCI department requires, all graduate students must register for at least one (1) research credit in order to continue to receive their stipend.

Before Leaving NDSU

Please toss all unwanted papers, magazines, etc. Make sure lab and office space are cleaned up and samples disposed of properly. Place all lab coats in bin for laundering. Please return keys to department office staff, if your keys or lab coats are not turned in, your supervisor will be charged for any coats and keys that are not returned.

Billing Address:

North Dakota State University
Pharmaceutical Sciences
Sudro 136
PO Box 6050 - Dept 2665
Fargo, ND 58108-6050

Shipping Address for FedEx, UPS, DHL Deliveries:

North Dakota State University
Pharmaceutical Sciences
(Name of Recipient)
1401 Albrecht Blvd. N.
Sudro 123
Fargo, ND 58105

Mailing Address for Items sent via USPS (Post Office)

North Dakota State University
(Name of Recipient)
Pharmaceutical Sciences
Sudro 123
PO Box 6050 - Dept 2665
Fargo, ND 58108-6050

Common Expenses: these charts are from the Accounting Office so you know what you need to hand in when asking for a reimbursement.

Common Expenses:
To claim the expenses below, please provide the indicated documentation and/or receipt. Please refer to the noted policies for questions.

A receipt shows full information, including the itemized details of the purchase, the total cost, and the method of payment, and is required for reimbursement of a particular expense.

Documentation of airfare/lodging/related items is necessary to show proof of travel times, dates, etc. but *if reimbursement is not requested, it does not need to show proof of payment.*

	Documentation of Business Purpose	Itemized Receipt	Itemized Airline Receipt	Itemized Hotel Receipt	Banquet Form and List of Attendees	Documentation of Air Travel	Documentation of Overnight Stay/Lodging	Documentation of Travel Time >4 Hours	Map of Travel Route	Fuel Receipts	Meeting or Training Agenda/Schedule	Conference Schedule	Student Travel Form (Student Employees)	Currency Conversion Documentation, if applicable	Travel Authorization (See NOSU Policy 515 section 3)	NOSU Policy 170: Payment of Meals for Staff & Guests	NOSU Policy 515: Travel - Employees	SPAE Policy & Procedure 806.1: Meals & Other Travel	OMB Policy/Policies	NOCCA 44-08-04: Expense Account	NOCCA 45-05-05: Mileage & Travel Expense
Business Purpose: Conference *See also Travel (Last Page) unless virtual	**Documentation Required**														**Related Policies**						
Abstract Submission	X	X										X	X								
Conference Meals Purchased	X	X									X	X			X	X	X	505	X		
Conference Registration Fee	X	X										X							X		
Membership Dues (to reduce conf. fees)	X	X										X						209			
Business Purpose: Employee Non-Travel	**Documentation Required**														**Related Policies**						
Banquet Meal (At least one guest present)	X	X			X						X				X	X	X				
Membership Dues	X	X																209			
Supplies/Postage/Books/Etc Purchased	X	X																			
Business Purpose: Group/Team Travel *See also Travel (Last Page)	**Documentation Required**														**Related Policies**						
Banquet Meal	X	X			X										X	X	X				
Supplies Purchased	X	X																			
Business Purpose: Meeting *See also Travel (Last Page)	**Documentation Required**														**Related Policies**						
Banquet Meal (At least one guest present)	X	X			X						X				X	X	X				
Staff meeting coffee/snack - not permitted	X	X			X						X				X		X	515			
Staff annual retreat meal (one per year)	X	X			X						X				X						
Supplies Purchased	X	X																			
Business Purpose: Monthly Expenses *See also Travel (Last Page)	**Documentation Required**														**Related Policies**						
Supplies/Postage/Books/Etc Purchased	X	X																			

Common Expenses:
To claim the expenses below, please provide the indicated documentation and/or receipt. Please refer to the noted policies for questions.

A receipt shows full information, including the itemized details of the purchase, the total cost, and the method of payment, and is required for reimbursement of a particular expense.

Documentation of airfare/lodging/related items is necessary to show proof of travel times, dates, etc. but *if reimbursement is not requested, it does not need to show proof of payment.*

	Documentation of Business Purpose	Itemized Receipt	Itemized Airline Receipt	Itemized Hotel Receipt	Banquet form and List of Attendees	Documentation of Air Travel	Documentation of Overnight Stay/Lodging	Documentation of Travel Time >4 Hours	Map of Travel Route	Fuel Receipts	Meeting or Training Agenda/Schedule	Conference Schedule	Student Travel Form (Student Employees)	Currency Conversion Documentation, if applicable	Travel Authorization (See NDSU Policy 515 Section 3)	NDSU Policy 170: Payment of Meals for Staff & Guests	NDSU Policy 515: Travel - Employees	SBHE Policy & Procedure 806.1: Meals & Other Travel	OMB Policy/Policies	NDCC 44-08-04: Expense Account	NDCC 54-06-09: Mileage & Travel Expense
Business Purpose: Off Site Work (Non Research) **See also: Travel (Last Page)	**Documentation Required**														**Related Policies**						
Banquet Meal (At least one guest present)	X	X			X										X	X	X				
Supplies/Postage/Books/Etc Purchased	X	X																			
Business Purpose: Off Site Work (Research) **See also: Travel (Last Page)	**Documentation Required**														**Related Policies**						
Banquet Meal (At least one guest present)	X	X			X										X	X	X				
Supplies/Postage/Books/Etc Purchased	X	X																			
Business Purpose: Professional Development	**Documentation Required**														**Related Policies**						
Class Fees	X	X														X			X		
Membership Dues	X	X											X					209			
Purchased Books/Supplies/Etc.	X	X																			
Business Purpose: Recruiting **See also: Travel (Last Page)	**Documentation Required**														**Related Policies**						
Banquet Meal (At least one guest present)	X	X			X										X	X	X				
Event Fees	X	X														X			X		
Supplies Purchased	X	X																			
Business Purpose: Training **See also: Travel (Last Page)	**Documentation Required**														**Related Policies**						
Banquet Meal (At least one guest present)	X	X			X					X					X	X	X				
Registration Fees	X	X														X			X		
Suppliers/Books/Postage Purchased	X	X																			

Common Expenses:
To claim the expenses below, please provide the indicated documentation and/or receipt. Please refer to the noted policies for questions.

A receipt shows full information, including the itemized details of the purchase, the total cost, and the method of payment, and is required for reimbursement of a particular expense.

Documentation of airfare/lodging/related items is necessary to show proof of travel times, dates, etc. but *if reimbursement is not requested, it does not need to show proof of payment.*

	Documentation of Business Purpose	Itemized Receipt	Itemized Airfare Receipt	Itemized Hotel Receipt	Banquet Form and List of Attendees	Documentation of Air Travel	Documentation of Overnight Stay/Lodging	Documentation of Travel Time >4 Hours	Map of Travel Route	Fuel Receipts	Meeting or Training Agenda/Schedule	Conference Schedule	Student Travel Form (Student Employees) if applicable	Currency Conversion Documentation, if applicable	Travel Authorization (See NDSU Policy 515 section 3)	NDSU Policy 170: Payment of Meals for Staff & Guests	NDSU Policy 515: Travel - Employees	SBHE Policy & Procedure 806.1: Meals & Other Travel	OMB Policy/Policies	NDCC 44-08-04: Expense Account	NDCC 54-06-08: Mileage & Travel Expense
In-State Travel	Documentation Required														Related Policies						
Lodging ($86.40 state rate)	X			X								X				X		505	X		
Hotel Parking	X	X		X								X				X		505			
Meals (Nontaxable) In-State (Overnight)	X						X								X	X	X	505	X		
Meals (Taxable) In-State	X							X							X	X	X	217	X		
Mileage (Pers. Vehicle) in City of Employment	X								X							X	X	507	X	X	
Mileage (Personal Vehicle) In-State	X								X							X	X	511	X	X	
Misc < $10. Cabs/Fees/Tolls/Parking, Etc	X														X			505	X		
Parking > $10	X	X										X				X		505			
Out-of-State Travel	Documentation Required														Related Policies						
Airfare Out of State	X	X	X									X		X		X		510			
Airport Parking	X	X				X						X		X		X		505			
Luggage Expense	X	X				X						X		X			X	510			
Cab/Uber/Lyft over $10 (Max $5 tip)	X	X										X		X		X		505			
Lodging	X			X								X		X		X	X	505	X		
Hotel Parking	X	X		X								X		X		X		505			
Meals (Nontaxable) Out-of-State	X						X					X		X	X	X	X	505	X		
Meals (Taxable) Out-of-State	X							X				X		X	X	X	X	217	X		
Mileage (Personal Vehicle) Out-of-State	X								X			X		X		X	X	511	X	X	
Misc < $10. Cabs/Fees/Tolls/Parking, Etc	X											X		X	X			505	X		
Parking > $10	X	X										X		X		X		505			
Rental Car (w/demonstrated cost benefit)	X	X				X				X		X		X		X		518			
International Travel	Documentation Required														Related Policies						
Airfare International	X	X	X									X	X	X		X	X	510			
Airport Parking	X	X				X						X		X		X		505			
Luggage Expense	X	X				X						X	X	X			X	510			
Cab/Uber/Lyft over $10 (Max $5 tip)	X	X										X	X	X		X		505			
Lodging	X			X								X	X	X		X	X	505	X		
Hotel Parking	X	X		X								X	X	X		X		505			
Meals International	X						X					X	X	X	X	X	X	505	X		
Mileage International (Personal Vehicle)	X								X			X	X	X		X	X	511	X	X	
Misc < $10. Cabs/Fees/Tolls/Parking, Etc	X											X	X	X	X			505	X		
Parking > $10	X	X										X	X	X		X		505			
Rental Car (w/demonstrated cost benefit)	X	X				X				X		X	X	X		X		518			

Guide to Reimbursable Expenses

This is a quick reference guide for North Dakota State University employees. It is not intended to replace the travel policies of North Dakota State University or the laws of the State of North Dakota. This guide contains examples of reimbursable and non-reimbursable expenses, but there are many different travel situations, and the department may still be asked to provide additional documentation or cost/benefit justification for any claimed expense.

General Travel Reminders:

Employees must choose the most prudent and economical means of travel, considering factors such as travel expenses, time away from the office, and the needs of the University. Employees may be asked to provide additional documentation or a cost/benefit justification to support a certain means of travel. Travelers need to exercise prudent judgment, common sense, and restraint when incurring travel costs, as these expenses must withstand the test of public scrutiny.

NDSU policy requires that employees have each out-of-state trip pre-approved by their immediate supervisor. In addition, the appropriate Vice President or Provost, or their designee must approve each trip to a foreign country.

When personal and business travel is combined, expenses must be clearly documented and reimbursement for airfare may not exceed the lowest available cost of a direct or uninterrupted route. If the traveler uses an indirect route or interrupts travel for personal convenience, any additional expenses incurred are the sole responsibility of the traveler.

Air Travel

What to Provide:
Full receipt showing payment method, flight dates and times, and a breakdown of fares, fees, taxes and extra amounts Documentation of business purpose

What is reimbursable: The lowest priced main cabin fare (plus required fees and taxes) available at the time of purchase – higher fares require documentation that the additional expense was necessary or unavoidable

Fees for one checked bag and one carry-on bag, if required.

The lowest cost option of: EITHER Uber/Lyft transportation to and from the airport, OR airport parking, for travel beginning one day prior to the event and ending one day after the event.

What is NOT reimbursable:
Use of discounts/coupons/frequent flyer miles – only the amount paid can be reimbursed

Mixed fee "bundles" such as Allegiant's "Total Bundle" (UNLESS the bundle is cheaper than purchasing the allowed items separately – occasionally a bundle is demonstrably cheaper than purchasing round-trip carry-on and checked luggage)

Seat selection fees or fare upgrades to business or first-class seating (may use earned frequent flyer miles for this expense)

Priority boarding

Additional baggage fees, unless a documented business need for additional baggage exists

Airport parking for personal travel days surrounding a business trip

Trip insurance or additional fees for refundable tickets

Taxi/Uber/Lyft

What to Provide:
Full itemized Uber/Lyft receipt including dates and times, trip origin and destination addresses, as well as all taxes, fees and tips, and method of payment. Daily email summaries of travel do not always provide sufficient information.

Documentation of purpose of travel

What is reimbursable:
Transportation between the airport and conference center or hotel

Transportation to/from business meetings that happen away from the lodging/conference center

Daily transportation between the lodging and conference center with documentation that this arrangement is a cost savings over staying at the conference hotel

Tips up to $5 for any approved trips

What is NOT reimbursable:
Transportation to/from meals, shopping, or entertainment visits

Tip amounts over $5 Uber Cash or similar payment options

Personal Vehicle Transportation

What to Provide:
Business purpose, including origin and destination locations – a map from Google Maps or similar source should be provided to verify the distance traveled, in most cases

For field work or rural site visits, please provide total miles traveled and description, such as: "Traveled 129 miles visiting 3 fields in Cass and Trail Counties"

What is reimbursable:
Mileage directly from the office to the meeting location or hotel

Mileage traveled while performing a series of site visits

Parking expenses at meeting locations, hotels, etc.

What is NOT reimbursable:
Fuel, parking tickets, vehicle maintenance and repairs

Mileage from home to work location

In-town driving in the destination community, unless business-related – any additional local trips must have details included, such as "drove from conference location to purchase supplies for presentation" or similar descriptions

Mileage that exceeds the map distance cannot be reimbursed without additional documentation

Hotel/Lodging

What to Provide:
Full itemized receipt showing dates of stay, room rate(s), taxes, fees, and method of payment, including proof of payment for any advance deposits

Documentation of business purpose is required for all lodging expenses

What is reimbursable:
Actual cost of lodging (for a single person) for out-of-state, or 90% of the GSA lodging rate for in-state, plus applicable taxes

Lodging for one day of travel before and one day of travel after a conference or event

Resort fees that are required

What is NOT reimbursable:
Alcohol, minibar, and entertainment expenses

Late check-out charges

Laundry

Meals charged to the room (per diem should be claimed for the meal)

In-state lodging that exceeds 90% of the GSA rate (unless documentation process in policy 515, part 7.1 is followed)

Conference Fees or Membership Fees

What to Provide:
Receipt showing purchase detail including name of conference or membership, full amount paid, and method of payment – include documentation of any cost savings resulting from the membership purchase

Schedule printout (not just a website link) showing the daily schedule, location, and any meals provided. Sample schedules are permitted if the main schedule is only available online.

What is reimbursable:
Membership fees for job-related organizations or that give reduced conference pricing, or show a demonstrable cost savings for a business-related purpose

Conference fees, including business-related ticketed meals (please note that per diem cannot be claimed for the quarter if a meal is provided at the conference)

Conference meal packages if the price of the package will provide a cost savings over the price of the per diem allowance for the conference dates and if it is evident that alcohol is not included

Necessary business travel to attend an in-person or hybrid conference

What is NOT reimbursable:
Entertainment related costs, including outings, meals, programs, parties or entertainment events

Alcohol-related costs, including drink tickets

Travel expenses related to a virtual conference with no in-person attendance option

Banquet Meals

What to Provide:
Banquet form showing business purpose, name of each attendee, and their title/relationship to NDSU

Fully itemized receipt from the restaurant/caterer showing what was purchased/served and the price per item

What is reimbursable:
Meals provided for a business function where a university guest is present

Meals provided for an annual staff retreat (limited to one per department per year)

Meal amounts up to (but not exceeding) 125% of the GSA rate for that meal period at that location

Gratuity up to 20% - provided the full price of the meal including gratuity is still under the 125% rule

What is NOT reimbursable:
Alcoholic beverages

Meals provided where the only attendees are NDSU employees and the meal is not for an annual staff retreat S

Snacks/drinks for staff or faculty meetings

*Any meal where the cost exceeds 125% of the GSA rate must be submitted to the Foundation for request for reimbursement for the full amount.

Per Diem Meals

What to Provide:
Travel details: begin time, end time, destination and business purpose

For overnight travel: proof of overnight lodging (lodging receipt or notation that the individual stayed with a friend/family member)

What is reimbursable:
Meals while traveling (away from the normal place of employment) for four hours or more

Out-of-state: all meals are reimbursable at the GSA rate in the city of the final destination

What is NOT reimbursable:
Any quarter per diem when that quarter's meal is provided at a meeting, training, conference, etc.

Any quarter per diem when the employee meal is reimbursed at actual receipt amount – for example, when an employee's meal is paid on a transaction that is included with a banquet form

First quarter per diem (6am-noon) if travel begins after 7am, or if the hotel/motel provides free breakfast

Second quarter per diem (noon-6pm) if travel ends prior to noon or begins after 1pm

Third quarter per diem (6pm-midnight) if travel ends prior to 6pm or begins after 7pm

Rental Vehicles

What to Provide:
Rental receipt from National/Enterprise/Hertz, business purpose, and documentation of the cost savings or necessity of renting the vehicle

If National/Enterprise/Hertz are not available, or if there is a cost-savings available, other rental agencies can be used – please provide the documentation of the reason for the alternate rental agency

What is reimbursable:
Cost of rental car, if the employee used an aircraft to get to their destination, and if the use of the vehicle is sufficient to justify that mode of travel instead of a cab

Required collision damage insurance, if no rental cars are available via the state contract – for more information please visit https://www.ndsu.edu/fileadmin/vpfa/forms/FM-RentalVehicleInformation.pdf

What is NOT reimbursable:
Purchase of additional insurance beyond the contracted insurance amounts

Miscellaneous Expenses

What to Provide:
Receipt for any miscellaneous expense over $10

Business purpose for each miscellaneous expense

What is reimbursable:
Reasonable gratuity (up to $5) provided to housekeeping, bellhop or other hotel staff

Toll fees

Class or registration fees

Business telephone calls (documentation of additional expense required)

What is NOT reimbursable:
Gratuity on a meal covered by the per diem allowance

Phone calls or personal cell phone use that do not cause additional expenses

Use of a personal data plan to provide a "hotspot" for remote work

Any expense without a valid business purpose