DRIVE Equipment

The numbered items below are also listed in the attached Excel document (CFI quotes are attached for the most expensive items):

I. Drug Discovery and Synthesis Unit (DDSU)

1. High-Performance Supercomputer (Exxact TensorEX TS4-130227231) *Approximate cost $34,000 (base with GPUs)*: GPU-accelerated server for large-scale AI, molecular dynamics, and virtual drug screening.

2. Mass spec/HPLC are critical for any drug discovery unit. A system that is particularly good for metabolites is needed, as many synthesized drugs are small molecules (metabolites), like the Orbitrap from Fisher Scientific, *$1.7M*). Drug synthesis cannot proceed without mass spec and its associated HPLC. An Orbitrap system is available at the proteomics center but has reached capacity and cannot support the needs of the DDSU. In an attached letter of support by Dr Fahlman (director of the proteomics center and of Biochemistry) it is explained that this is not only needed by would be transformative for the center itself. The Orbitrap/HPLC will be placed within the proteomics center, where strong expertise exists.

3. Automated Microwave Chemistry System (Biotage Initiator+ with Robot Sixty) *Approx. $85,000*. This system accelerates the drug discovery process from hours to minutes and automates parallel chemical reactions for compound library generation. It is expected that at full capacity the DDSU will be working on 4-5 drugs at any given time, so an efficient process is essential to shorten the duration of the process.

4. Preparative Purification System (ACCQPrep HP150, Teledyne Isco) *Approx. $70,000*: HPLC-based platform that isolates and purifies synthesized compounds for biological testing.

5. High-Speed Evaporation System (Biotage V-10 Touch) *Approximate cost $56,000*. This system rapidly removes solvents, even difficult to work-with solvents, using vortex evaporation for efficient compound concentration.

6. Benchtop Reactor System (Mettler Toledo RX-10) *Approximate cost. $17,000*: Computer-controlled reactor for precise, reproducible small- to mid-scale chemical synthesis, like the one needed for the DDSU.

7. Glove Box Workstation (MBRAUN LABmaster) *Approximate cost. $100,000*: Inert-atmosphere chamber for handling oxygen or moisture-sensitive reagents that are almost always used in drug chemical synthesis.

8. Access Workstation (ECHO Robotic Liquid Handler) *Approximate cost $1.6M*: This robotic acoustic liquid-handling system uses focused sound waves to move nanoliter-sized droplets between thousands of wells without any physical contact. Pipetting at this scale is physically impossible by hand or even with standard robots, and this technology allows us to transfer samples directly from high-throughput compound plates while preserving every drop and preventing contamination. It integrates with the SPR 64 instrument (part of Dr. Tabatabaei's JELF application), where the robotic arm continuously feeds prepared samples for real-time measurement of drug and target binding. Operating together, the two systems can screen up to 18,000 compound–target interactions per day, generating precise binding data that would otherwise take months to obtain manually, in a single day. In addition to small-molecule drug screening, the system can also quantify protein–peptide and protein–protein interactions with high sensitivity, enabling kinetic studies of complex biological systems. Unlike conventional SPR instruments that require purified recombinant proteins, this integrated setup can perform binding measurements directly from cell lysates, allowing the study of native protein conformations and post-translationally modified targets. To the best of our knowledge, this setup would be the first of its kind in a Canadian research institution and a CFI quote is attached.

None of these machines are currently available at the U of A. Space for the DDSU will be available within the currently available 5,000 square feet of the CVRC which is now integrated with the

CVRI. Two HQPs are requested for the DDSU (1 for the mass spec and 1 chemist for drug synthesis is requested for the DDS).

II. Comprehensive Human Phenotyping Unit (CHPU)

9. An ILUMINA NovaSeq X Plus machine (*Approximate cost $1.7M*) will be needed. It can do genomic, transcriptomics, epigenomics (i.e., DNA methylation) and proteomics analysis (from the same sample) on bio-banked human blood or biopsies (to mechanistically understand their interaction in disease), to discover targets and biomarkers. Such a high throughput system, able to efficiently study hundreds or thousands of human samples is lacking at the U of A, significantly compromising its translational and clinical research potential, compared to provinces like BC or Quebec that do have such capability. A Sequencer is available at the U of A sequencing facility, but it is not set up for large scale human studies. The strength of this system is that it can do all OMICs from the same sample, using different re-agents for each and ILUMINA custom-made proteomic chips for screening 300 to >3,000 proteins and epigenetic markers (i.e., DNA methylation patterns like DNAm clocks essential for ageing studies).
10. ARCTURUS laser-captured microdissection for isolation of cells from fresh or processed biopsies is needed to isolate specific cell groups (e.g. endothelial vs media layer in blood vessels) for RNA, DNA or protein). *Approximate estimated cost: $300,000.*
11. A microtome is needed to process the human tissues (biopsies from the OR or transplant organs during ex vivo perfusions). *Approximate cost: $27,000.*
12. A digital PCR/RT-PCR machine. *Approximate cost: $115,000.*
13. A robotic system for high throughput loading of human blood (e.g., Hamilton STAR). *Approximate estimated cost: $400,000*. This is important for an efficient high-throughput processing from many patient samples "fed" into the sequencer
14. A data storage server with a laboratory management system, linked to the NovaSec Plus machine (*Approximate estimated cost*: *$40,000*).
15. Two hoods dedicated for sterile human tissue/blood processing. *Approximate cost: $28,000.*
16. An ultracentrifuge system dedicated for human sample processing. *Approximate cost: $310,000.*
17. Digital -80C freezers x3. *Approximate cost: $118,000.*
The ABACUS research space in the MAZ basement (previously supporting a CFI-funded unit 20 years ago) has space for the above equipment for the CHPU. Three HQPs are requested: one technician to process the samples, one to operate the sequencer, and one bio-statistician for the processing and analysis of the OMICs data.

III. Comprehensive Animal Phenotyping Unit (CAPU)

The sections of the CAPU include: **A.** Live animal phenotyping, **B**. Whole organ phenotyping (rodents and pigs), and **C.** Molecular Phenotyping at the cellular level.

A. Live animal phenotyping

The CVRC/CVRI contains a variety of sophisticated equipment designed to allow for phenotyping rodents, including an in vivo small animal micro-PET/MRI allowing simultaneous anatomic and functional imaging of rodents, metabolic cages and echocardiographic systems for in vivo calorimetry and cardiovascular ultrasound, respectively. Additional items needed include:
18. A CAPRAC-T wipe test/well counter is needed for the PET system (*Approximate cost:* $*21,000*), allowing for safe monitoring of radioisotope use in the room.
19. The EchoMRI system, which is a body composition analyzer that allows us to measure fat, lean, total water, and free water mass in live animals, will need to be updated as it is heavily utilized and needs an update (*Approximate cost*: *$460,000*).
20. A Newton 7.0 system is needed for in vivo optical imaging of bioluminescence, fluorescence, and 3D tomographic imaging of rodents (*Approximate cost*: *$693,000*). Using. With this equipment, the

DRIVE scientists will be able to non-invasively track biological processes like tumor growth, disease progression, and gene expression in living treated and transgenic animals.

21. A VivaMARS Mobile Activity Rack System for activity and behavioral phenotyping of rats and mice is needed (*Approximate cost*: *$765,000*) which was originally designed for neurotoxicology and neuropharmacology studies. This will allow for behavioral phenotyping by tracking rat or mouse locomotor activity, fine movements rearing/jumping, and tracking distance travelled as well as speed. This will enhance the behavioural assessments that are already ongoing with other equipment in the existing core. It is very important for ageing studies, as well as investigation of potential CNS unexpected effects of newly synthesized drugs or gene knockouts.

22. A blood gas and hemoscreen CBC analyzer (*Approximate cost*: *$35,000*) to measure blood gases as well as complete blood count, renal and liver panels for further characterization of animal phenotypes.

23. A telemetry system for blood pressure and ECG monitoring. *Approximate cost*: *$325,000.* The ECG telemetry component is needed to monitor 10 rats and another for 10 mice for the detection of arrhythmias and sudden death that can complicate drug-treated animals or transgenic animals. The invasive blood pressure monitoring system is essential for comprehensive cardiovascular phenotyping.

24. An invasive heart catheterization of anesthetized rats/mouse system needs to be updated (new Millar catheters and anesthetic/respirator machine, *Approximate estimated cost*: *$80,000*).

B. Whole organ phenotyping

25. A custom-made **mouse/rat heart perfusion system** that allows us to measure cardiac metabolic flux rates using radiotracers of appropriate substrates. This is important, given the strong interest of CVRI, ADI and WCRI researchers in studying cardiac energy metabolism. For this, we will utilize some existing equipment as well as update the existing oxygen flow probes (*Approximate estimated cost*: *$150,000*).

26. A new liquid scintillation counter (*Approximate cost*: *$186,000*) to replace the existing one that is nearly 20 years old.

C. Molecular Phenotyping

27. A cell and tissue processing unit with 2 additional hoods. *Approximate cost: $28,000.*

28. Three additional -80 freezers, so that our researchers have the capability to store tissue for future work *Approximate cost: $119,000.*

29. Real-time PCR, nanodrop, multimode reader, single cell immunoblot system, ChemiDoc™ MP Imaging System. *Approximate cost: $650,000.*

30. Two centrifuges (none of the existing ones work), will be needed so that our researchers have the capability to perform extensive molecular characterization of their human or animal tissue samples. *Approximate cost: $19,000.*

31. This item was requested by the transgenic core: Dry Shipper and Ultrasonic Cryosealer (current ones are near end of life), will be needed for a safe, compliant method to share or import cryopreserved material without relying on the second party to provide one, while improving sample security and reduces failed thaw events — all valuable for high-throughput, reproducible cryopreservation workflows of all transgenic animals stored at the U of A. *Approximate estimated cost: $15,000.*

32. This item was requested by the transgenic core: Tecniplast ISOcage negative ventilated caging rack, will be needed to isolate transgenic animals from general populations to ensure strict biosecurity measures are maintained, while rederivation processes are carried out within the transgenic core to clean up strains. *Approximate cost: $100,000*

The CAPU equipment will be housed in the existing 5,000 square feet space of the CVRC/CVRI, except for items 31 and 32 which will be housed in the transgenic core. Two HQPs are requested: one to support the existing PET/MRI (that currently lacks an operator) and one for the rest of the CAPU, 0.5 of which will support the transgenic core that will collaborate with the CAPU in the phenotyping of the transgenic animals that it generates (see letter of support).