

ARRTI

Alberta RNA Research and Training Institute

ANNUAL REPORT 2017 – 2018

University of
Lethbridge



MAY 1, 2017 TO
APRIL 30, 2018

WWW.ULETH.CA/RESEARCH/ARRTI

TWITTER: @ARRTI_RNA

Mandate

ARRTI is dedicated to foster and facilitate RNA research and training excellence at the University of Lethbridge and to contribute to the multidisciplinary research and teaching community at the University of Lethbridge and its surrounding communities.

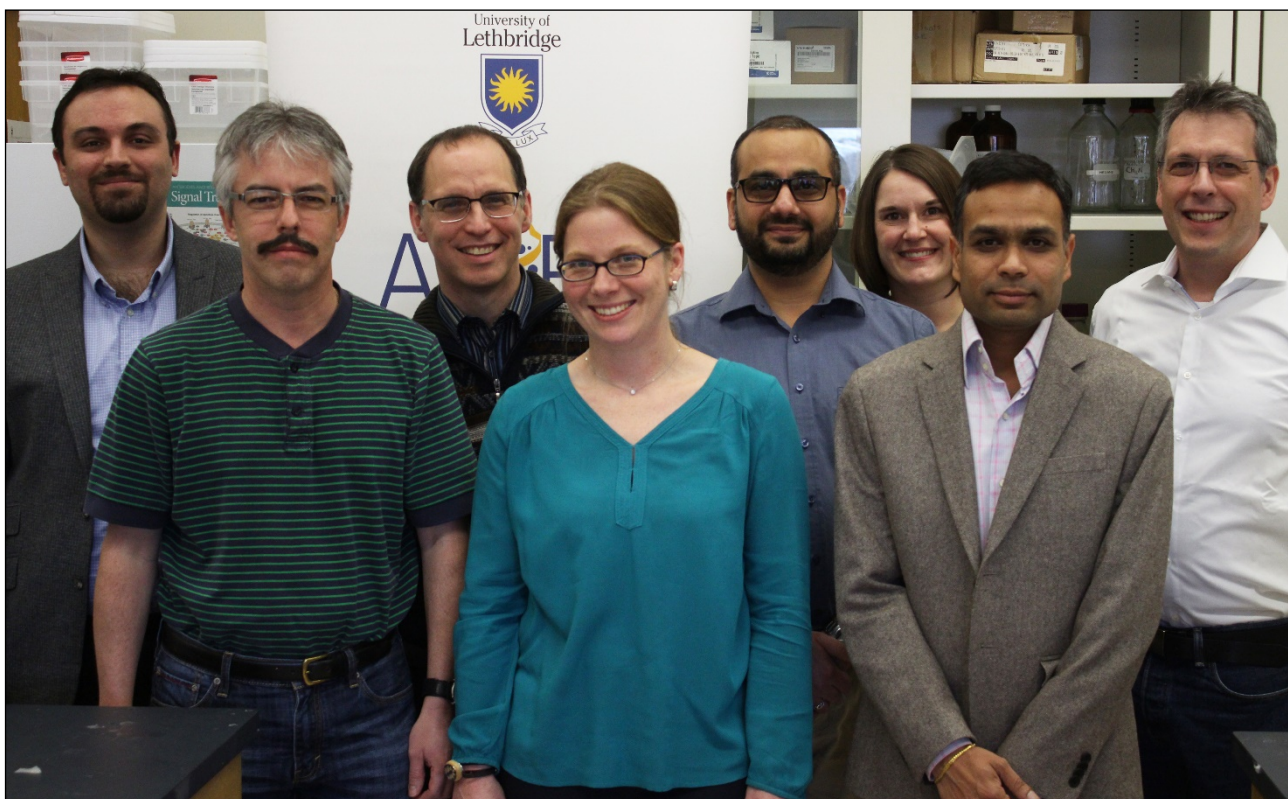
Members

Director – Hans-Joachim Wieden (Department of Chemistry and Biochemistry)

Associate Director – Tony Russell (Department of Biological Sciences)

Research Members –

- Ute Kothe (Department of Chemistry and Biochemistry)
- Marc Roussel (Department of Chemistry and Biochemistry)
- Nehal Thakor (Department of Chemistry and Biochemistry)
- Stacey Wetmore (Department of Chemistry and Biochemistry)
- Trushar Patel (Department of Chemistry and Biochemistry)
- Athanasios Zovoilis (Department of Chemistry and Biochemistry)



(L-R) Dr. Zovoilis, Dr. Russell, Dr. Roussel, Dr. Kothe, Dr. Thakor, Dr. Wetmore, Dr. Patel and Dr. Wieden.

Visiting Professors – Dr. Purshotam Sharma and Dr. Joseph Lane were visiting the laboratory of Dr. Stacey Wetmore.



ARRTI Group (May 2017) in front of University of Lethbridge Destination Project construction
Photo Credit: Douglas Mackintosh



ARRTI Group (May 2018) in front of University of Lethbridge Destination Project construction
Photo Credit: Elaine Van Rootselaar

Recruitment

1. Canada 150 Research Chair in Biophysics
 - Dr. Borries Demeler (Expected to start August 1, 2018)
2. Postdoctoral Fellows
 - Dr. Julia Guegueniat (Kothe Lab)
 - Dr. Mohamed Aboelnga (Wetmore Lab)
 - Dr. Soumya Deo (Wieden Lab)
3. Research Associates
 - Babita Gollen (Laboratory Manager for Zovoilis Lab)
 - Angeliki Pantazi (Genome Interpretation Specialist for Zovoilis Lab)

Trainees

Total trainees between May 1, 2017 and April 30, 2018: 98

Postdoctoral Fellows – 8

- Four Postdoctoral Fellows completed their programs at ARRTI
 - Dr. Andrew Hudson now works as the Biology Lab Manager at the University of Lethbridge
 - Dr. Anne-Sophie Tillault now works as a Postdoctoral Fellow at the University of Lethbridge with Dr. Dmytro Yevtushenko
 - Dr. Rajashekhar Kamalampeta is now a freelance Science Educator in India
 - Dr. Senthilkumar Kailasam now works as a Postdoctoral Fellow at McGill University with Dr. Hamed Najafabadi

Research Associates – 8

PhD Students – 19

- 2 students successfully defended their dissertation during this reporting period
 - Dr. Shahin Sowlati-Hashjin is now a Postdoctoral Associate at Western University
- 5 students began a PhD program during this reporting period (all recruited externally)

MSc Students – 20

- 5 students successfully defended their thesis during this reporting period
 - Katherine Gzyl is now a Researcher for Agriculture and Agri-Food Canada
 - Nirujah Balasingam is now a Research Assistant at the University of Calgary
- 7 students began an MSc program during this reporting period (4 recruited externally, 3 recruited internally)

Undergraduate Students – 41

Exchange Students – 1

High School Students – 2

Note: Trainees who completed a BSc or MSc and moved on to an MSc or PhD, respectively, are only listed under their current category, to avoid counting any trainee twice.

ARRTI Lab Representatives (2017-18)

- Wieden – Taylor Sheahan
- Russell – David McWatters
- Kothe – Dominic Czekay
- Roussel – Hossein Hosseini
- Thakor – Jean Claude Nshogozabahizi
- Wetmore – Stefan Lenz
- Patel – Tyler Mrozowich
- Zovoilis – Chris Isaac

RNA Bioengineering and Innovation Network

ARRTI members, in conjunction with RiboClub members at the Université de Sherbrooke, have been successful in their application for an NSERC Collaborative Research and Training Experience Program (CREATE) grant to develop a new training program.

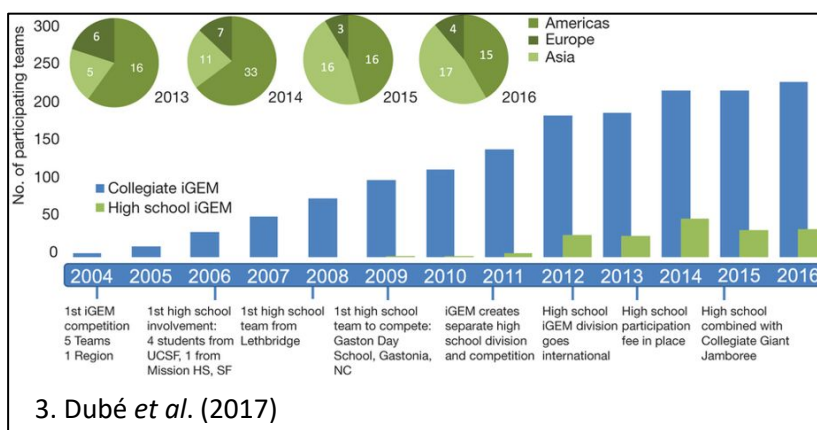
Through the development of the NSERC CREATE training program, we have engaged with a number of companies such as Dow AgroScience, NEB, Designer Microbes and Integrated DNA Technologies (IDT) to develop these knowledge transfer pipelines. This program will enhance the training environment for ARRTI students, with leadership courses, exchanges with Sherbrooke, and industrial opportunities. Trainees will work together to solve a problem posed by an industry partner, as well as receiving internship placements. The program will provide the training required for our students to become the next generation of industrial scientists, as well as providing the networking prospects to ensure their career success.

Research Dissemination

Journal articles published – 27

1. Gzyl, K.E. and **Wieden, H.-J.*** (2017) Tetracycline Does Not Directly Inhibit the Function of Bacterial Elongation Factor Tu. *PLoS ONE* **12**(5): e0178523. DOI: 10.1371/journal.pone.0178523. (IF: 3.057)
2. Ingalls, B.*, Mincheva, M., and **Roussel, M.R.** (2017) Parametric Sensitivity Analysis of Oscillatory Delay Systems with an Application to Gene Regulation. *Bull. Math. Biol.* **79**: 1539-1563. DOI: 10.1007/s11538-017-0298-x (IF: 1.263)

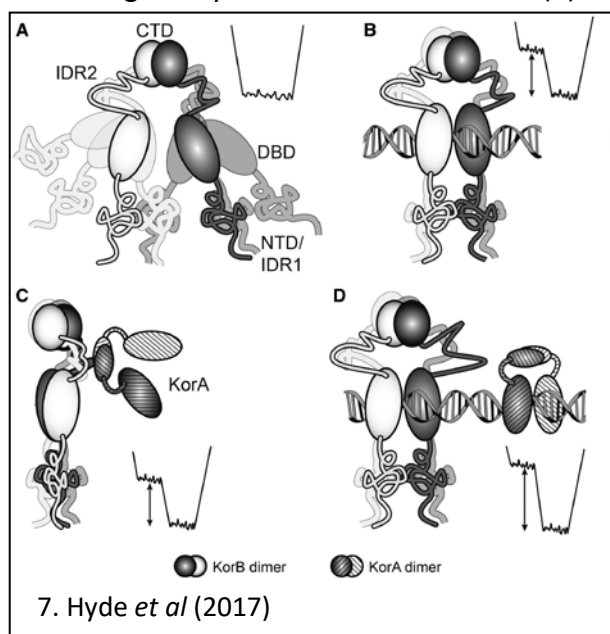
3. Dubé, S., Orr, D., Dempsey, B., and **Wieden, H.-J.*** (2017) A Synthetic Biology Approach to Integrative High School STEM Training. *Nature Biotechnol.* **35**: 591-595. DOI: 10.1038/nbt.3896 (IF: 43.113)



4. Negi, I., Kathuria, P. Sharma, P.* and **Wetmore, S.D.*** (2017) How do hydrophobic nucleobases differ from natural DNA nucleobases? Comparison

of structural features and duplex properties from QM calculations and MD simulations. *Phy. Chem. Chem. Phys.* **19**: 16365-16374. DOI: 10.1039/C7CP02576A (IF: 4.123) (*Themed Collection 2017 PCCP HOT Articles*)

5. Wilson, K.A., Szemethy, K.G., and Wetmore, S.D. (2017) Conformational flexibility and base-pairing tendency of the tobacco carcinogen O6-[4-oxo-4-(3-pyridyl)butyl]guanine. *Biophysical Chemistry* **228**: 25-67. DOI: 10.1016/j.bpc.2017.06.001 (IF: 1.28)
6. Kathuria, P., Sharma, P., Manderville, R.A. and **Wetmore, S.D.*** (2017) Molecular Modeling of the Major DNA Adduct Formed from Food Mutagen Ochratoxin A in *NarI* Two-Base Deletion Duplexes: Impact of Sequence Context and Adduct Ionization on Conformational Preference and Mutagenicity. *Chem. Res. Toxicol.* **30**(8): 1582-1591. DOI: 10.1021/acs.chemrestox.7b00103 (IF: 3.278)



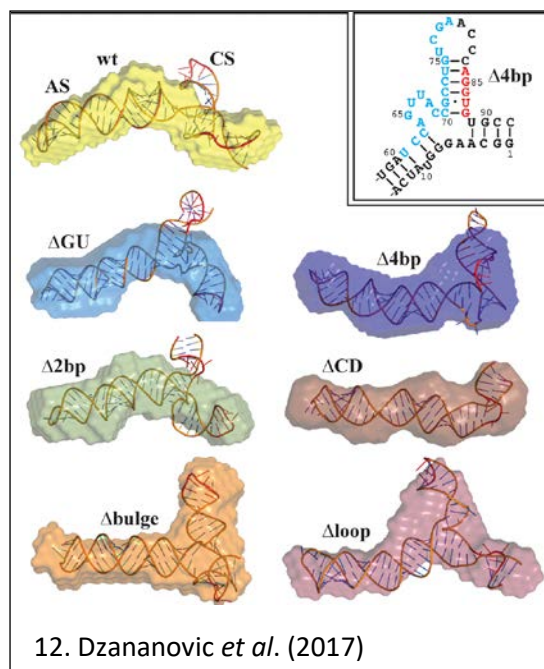
7. Hyde, E.I.*, Callow, P., Rajesekar, K.V., Timmins, P., **Patel, T.R.**, Siligardi, G., Hussain, R., White, S.A., Thomas, C.M. and Scott, D.J.* (2017). Intrinsic disorder in the partitioning protein KorB persists after cooperative complex formation with operator DNA and KorA. *Biochem. J.* **474**(18): 3121–3135. DOI: 10.1042/BCJ20170281 (IF: 3.797)
8. Wilson, K.A. and Wetmore, S.D.* (2017) Conformational Flexibility of the Benzyl-Guanine Adduct in a Bypass Polymerase Active Site Permits Replication: Insights from Molecular Dynamics Simulations. *Chem. Res. Toxicol.* **30**(11):2013-2022. DOI: 10.1021/acs.chemrestox.7b00179 (IF: 3.278)

9. Turnbull, D., **Wetmore, S.D.**, and Gerken, M.* (2017) Syntheses and Characterization of W(NC6F5)F5– and W2(NC6F5)2F9– Salts and Computational Studies of the W(NR)F5– (R = H, F, CH3, CF3, C6H5, C6F5) and W2(NC6F5)2F9– Anions. *Inorg. Chem.* **56**(20): 12581-12593. DOI: 10.1021/acs.inorgchem.7b02048 (IF: 4.857)

10. **Patel, T.R.***, Winzor, D.J. and Scott, D.J.* (2017) Allowance for radial dilution in evaluating the concentration dependence of sedimentation coefficients for globular proteins. *Eur. Biophys. J.* **47**(3): 281-286. DOI: 10.1007/s00249-017-1259-x (IF: 1.472)

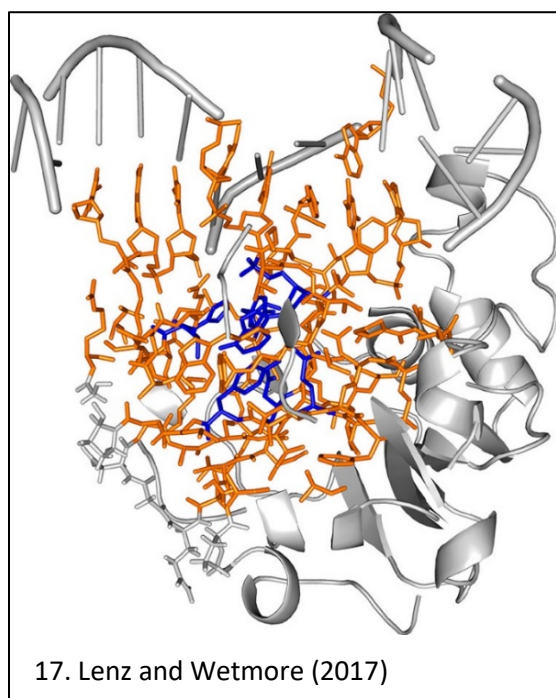
11. Fernandes, D.D., Bamrah, J., **Kailasam, S.**, Gomes, G.-N.W., Li, Yi, **Wieden, H.-J.**, and Gradinaru, C.C.* (2017) Characterization of Fluorescein Arsenical Hairpin (FIAsH) as a Probe for Single-Molecule Fluorescence Spectroscopy. *Sci. Rep.* **7**: 13063. DOI: 10.1038/s41598-017-13427-8 (IF: 4.847)

12. Dzananovic, E., Chojnowski, G., **Deo, S.**, Booy, E.P., Padilla-Meier, P., McEleney, K., Bujnicki, J.M., **Patel, T.R.*** and McKenna, S.A.* (2017). Structural integrity of the central stem-loop of adenovirus VAI RNA is essential for PKR inhibition. *PLoS One* **12**(10): e0186849, 1-21. DOI: (IF: 2.80)



13. Kaur, S., Sharma, P.*, and **Wetmore, S.D.*** (2017) Structural and electronic properties of barbituric acid and melamine-containing ribonucleosides as plausible components of prebiotic RNA: implications for prebiotic self-assembly. *Phys. Chem. Chem. Phys.* **19**(45): 30762-30771. DOI: 10.1039/c7cp06123d (IF: 4.123)

14. **Smith, D.D.**, **Girodat, D.**, **Wieden, H.-J.*** and Selinger, L.B.* (2017) Streamlined purification of fluorescently labeled *Escherichia coli* phosphate-binding protein (PhoS) suitable for rapid-kinetics applications. *Anal. Biochem.* **537**: 106-113. DOI: 10.1016/j.ab.2017.09.012 (IF: 2.219)

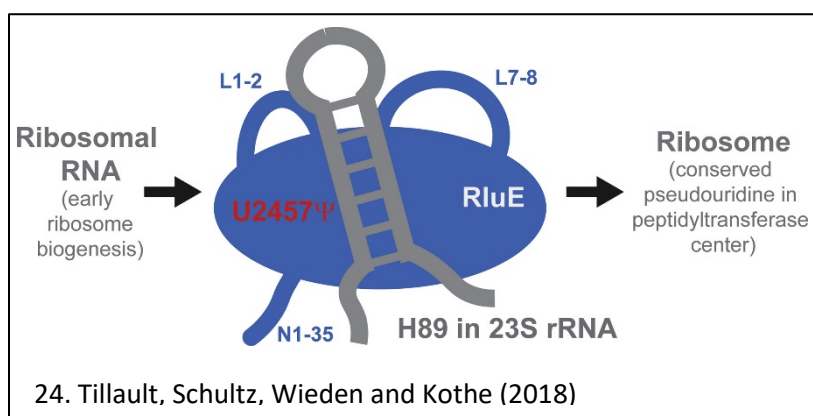


15. **Caton, E.A.**, **Kelly, E.K.**, **Kamalampeta, R.**, and **Kothe, U.*** (2017) Efficient RNA pseudouridylation by eukaryotic H/ACA ribonucleoproteins requires high affinity binding and correct positioning of guide RNA. *Nucleic Acids Res.* **46**(2): 905-916 DOI: 10.1093/nar/gkx1167 (IF: 10.162)

16. Stuart, D., **Wetmore, S.D.** and Gerken, M.* (2017) Solid-State Structure of Protonated Ketones and Aldehydes. *Angew. Chem. Int. Ed. Eng.* **56**(51): 1638-16384. DOI: 10.1002/anie.201710263 (IF: 11.994)

17. **Lenz, S.A.P.** and **Wetmore, S.D.*** (2017) QM/MM Study of the Reaction Catalyzed by Alkyladenine DNA Glycosylase: Examination of the Substrate Specificity of a DNA Repair Enzyme. *J. Phys. Chem. B.* **121**(49): 11096-11108. DOI: 10.1021/acs.jpcc.7b09646 (IF: 3.177)

18. Hudson, A.J., Glaister, G.D., and **Wieden, H.-J.*** (2017) The Emergency Medical Service Microbiome. *Appl. Environ. Microbiol.* **84**(5): e02098-17. DOI: 10.1128/AEM.02098-17 (IF: 3.807) (*Spotlight Article*)
19. Krahn, N., Meier, M., Booy, E.P., Vu, T., McEleney, K., O'Neil, J., McKenna, S.A., **Patel T.R.*** and Stetefeld, J.* (2017) Nano-scale assembly of high-mobility group AT-hook 2a protein with DNA replication fork. *Biophys. J.* **113**(12): 2609-2620. DOI: 10.1016/j.bpj.2017.10.026 (IF: 3.65)
20. Felske, L.R., Lenz, S.A.P., and **Wetmore, S.D.*** (2018) Quantum Chemical Studies of the Structure and Stability of N-Methylated DNA Nucleobase Dimers: Insights into the Mutagenic Base Pairing of Damaged DNA. *J. Phys. Chem. A.* **122**(1): 410-419. DOI: 10.1021/acs.jpca.7b10485 (IF: 2.847) (*Invited article*)
21. Sowlati-Hashjin, S. and **Wetmore, S.D.*** (2018) Structural Insight into the Discrimination between 8-Oxoguanine Glycosidic Conformers by DNA Repair Enzymes: A Molecular Dynamics Study of Human Oxoguanine Glycosylase 1 and Formamidopyrimidine-DNA Glycosylase. *Biochemistry* **57**(7): 1144-1154. DOI: 10.1021/acs.biochem.7b01292 (IF: 2.938)
22. Berger, F.D., Sturla, S.J.*, Kung, R.W., Montana, T., **Wetmore, S.D.*** and Manderville, R.A.* (2018) Conformational Preference and Fluorescence Response of a C-Linked C8-Biphenyl-Guanine Lesion in the *NarI* Mutational Hotspot: Evidence for Enhanced *Syn* Adduct Formation. *Chem. Res. Toxicol.* **31**(1): 37-47. DOI: 10.1021/acs.chemrestox.7b00266 (IF: 3.278)
23. **Patel, T.R.***, Besong, T.M.D., Meier, M., McEleney, K., Harding, S. and Stetefeld, J.* (2018) Interaction studies of a protein and carbohydrate system using an integrated approach: a case study of miniagrin - heparin system. *Eur. Biophys. J.* DOI: 10.1007/s00249-018-1291-5 (IF: 3.97)
24. Tillault, A.-S., Schultz, S.K., **Wieden, H.-J.**, and **Kothe, U.*** (2018) Molecular determinants for 23S rRNA recognition and modification by the *E. coli* pseudouridine synthase RluE. *J. Mol. Biol. In Press.* DOI: 10.1016/j.jmb.2018.03.011 (IF: 4.632)



25. Tanzawa, T., Kato, K., Girodat, D., Kumakura, Y., **Wieden, H.-J.**, Uchiumi, T., Tanaka, I., and Yao, M.* (2018) The C-terminal helix of ribosomal P stalk recognizes a hydrophobic groove of elongation factor 2 in a novel fashion. *Nucl. Acids Res.* **46**(6): 3232-3244. DOI: 10.1093/nar/gky115 (IF: 10.162)

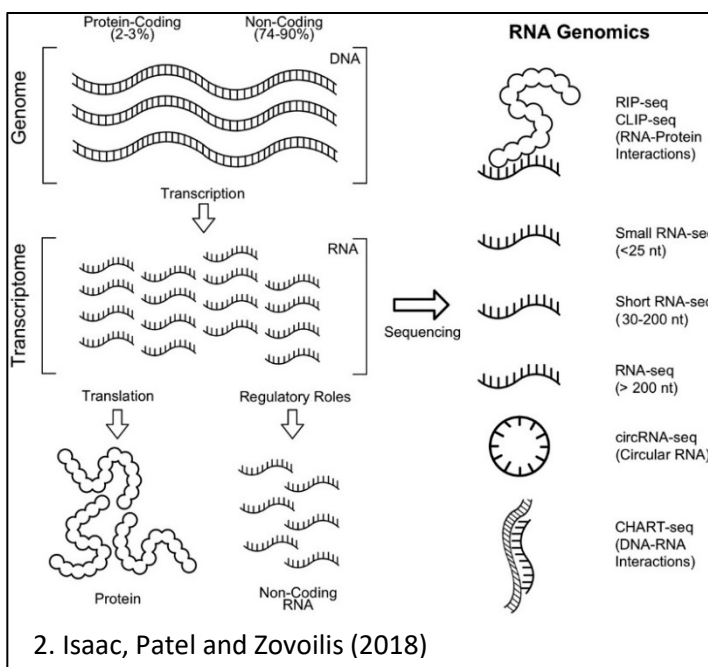
26. Meier-Stephenson, V., Mrozowich, T., Pham, M. and **Patel, T.R.*** (2018) DEAD-box Helicases: The Yin and Yang roles in viral infections *Biotechnol. Genet. Eng. Rev. In Press.* DOI: 10.1080/02648725.2018.1467146 (IF: 0.929)
27. Dznanovic, E., McKenna, S.A.* and **Patel, T.R.*** (2018). Viral proteins targeting host protein kinase R to evade an innate immune response: a mini review. *Biotechnol. Genet. Eng. Rev. In Press.* DOI: 10.1080/02648725.2018.1467151 (IF: 0.929)

Journal articles under review before April 30, and now published – 7

1. **Roberts, L. and Wieden, H.-J.*** (2018) Viruses, IRESS, and A Universal Translation Initiation Mechanism. *Biotechnol. Genet. Eng. Rev. In Press*. DOI: 10.1080/02648725.2018.1471567 (IF: 0.929)

2. **Isaac, C., Patel, T.R. and Zovoilis, A.** (2018) Non-coding RNAs in Virology: an RNA Genomics Approach. *Biotechnol. Genet. Eng. Rev. In Press*. DOI: 10.1080/02648725.2018.1471642 (IF: 0.929)

3. **Meier, M.*, Moya, A., Krahn, N., McDougal, M., McRae, E.K.S., Booy, E.P., Patel, T.R., McKenna, S.A. and Stetefeld J.*** (2018). Structure and hydrodynamics of a DNA G-quadruplex



with a cytosine bulge. *Nucleic Acids Res.*, 1-13. DOI: 10.1093/nar/gky307 (IF: 10.16)

4. **Ross, J.A. and Thakor, N.*** (2018) Toeprinting Analysis of Translation Initiation Complex Formation on Mammalian mRNAs. *J. Vis. Exp.* **135**: e57519. DOI: 10.3791/57519 (IF: 1.232)

5. **Van Riesen, A.J., Fadock, K.L., Deore, P.S., Desoky, A., Manderville, R.A.*, Sowlati-Hashjin, S. and Wetmore, S.D.*** (2018) Manipulation of a DNA aptamer-protein binding site through arylation of internal guanine residues. *Org. Biomol. Chem.* **16**(20): 3831-3840. DOI: 10.1039/c8ob00704g (IF: 3.564)

6. **Cai, A., Wilson, K.A., Patnaik, S., Wetmore, S.D. and Cho, B.P.*** (2018) DNA base sequence effects on bulky lesion-induced conformational heterogeneity during DNA replication. *Nucleic Acids Res. In Press*. DOI: 10.1093/nar/gky409 (IF: 10.162)

7. **Dahlman, H.A., Berger, F.D., Kung, R.W., Wyss, L.A., Gubler, I, McKeague, M., Wetmore, S.D., and Sturla, S.J.** (2018) Fluorescent elongated hydrophobic nucleobase analogues stabilize DNA duplexes containing O^6 -alkylguanine adducts. *Helv. Chim. Acta. In Press*. DOI: 10.1002/hlca.201800066 (IF: 1.071)

Journal articles accepted and awaiting publication – 5

1. **Roussel, M.R.*** (2017) A delayed mass-action model for the transcriptional control of Hmp, an NO detoxifying enzyme, by the iron-sulfur protein FNR. In Giorgio Valmorbidia, Alexandre Seuret, Rifat Sipahi and Islam Boussaada (Eds.), *Delays and Interconnections: Methodology, Algorithms and Applications*, forthcoming volume in *Springer series Advances in Delays and Dynamics*. (Invited paper)

2. Cai, A., Wilson, K.A., Patnaik, S., **Wetmore, S.D.** and Cho, B.P.* (2018) DNA Base Sequence Effects on Bulky Lesion-Induced Conformational Heterogeneity during Simulated Translesion Synthesis. *Nucleic Acids Res. Accepted for publication.*
3. Van Riesen, A.J., Fadock, K.L., Deore, P.S., Desoky, A., Manderville, R.A.*, Sowlati-Hashjin, S., and **Wetmore, S.D.*** (2018) Manipulation of a DNA Aptamer-Protein Binding Site through Arylation of Internal Guanine Residues. *Org. Biomol. Chem. Accepted for publication.*
4. Kung, R.W., Sharma, P., and **Wetmore, S.D.*** (2018) Effect of the size and shape of nitrogen-containing aromatics on the conformational preferences of DNA containing damaged guanine: Insights from quantum chemical calculations and molecular dynamics simulations. *J. Chem. Info. Model. Accepted for publication.*
5. Kathuria, P., Sharma, P., Manderville, R.A., and **Wetmore, S.D.*** (2018) Molecular dynamics simulations of mismatched DNA duplexes associated with the major C8-linked 2'-deoxyguanosine adduct of the food mutagen ochratoxin A: Influence of opposing base, adduct ionization state and sequence on the structure of damaged DNA. *Chem. Res. Toxicol. Accepted for publication.*

Journal articles under review – 2

1. Kotb, A., Hyndman, E. and **Patel, T.R.*** (2018). The role of zyxin in regulation of malignancies. *Heliyon.* (Submitted)
2. Mrozowich, T., McLennan, S., Overduin, M. and **Patel T.R.** (2018). Structural Studies of Macromolecular Interactions in Solution using Small Angle X-Ray Scattering. *J. Vis. Exp.* (Submitted)

Mathematical reviews – 6

1. MR3567973: Stability of stationary solutions in models of the Calvin cycle. By S. Disselkötter and A.D. Rendall (Review by **Roussel, M.R.**)
2. MR3590674: The effect of site-to-site variability in ultrasensitive dose responses. By G.A. Enciso and S. Ryerson. (Review by **Roussel, M.R.**)
3. MR3600428: Multiscale modelling and analysis of signalling processes in tissues with non-periodic distribution of cells. By M Ptashnyk. (Review by **Roussel, M.R.**)
4. MR3637893: A chaotic bursting-spiking transition in a pancreatic beta-cells system: observation of an interior glucose-induced crisis. By J. Duarte, C. Januário and N. Martins (Review by **Roussel, M.R.**)
5. MR3679308: Finite time distributions of stochastically modeled chemical systems with absolute concentration robustness. By D.F. Anderson, D. Cappalletti and T.G. Kurtz (Review by **Roussel, M.R.**)
6. MR3711575: Reduction for stochastic biochemical reaction networks with multiscale conservations. By J.K. Kim, G.A. Rempala and H.-W Kang (Review by **Roussel, M.R.**)

Theses – 7

1. Katherine Elizabeth Gzyl, M.Sc. (2017) The role of tetracycline and macromolecular crowding on the function of elongation factor-Tu. Supervisor: Dr. Hans-Joachim Wieden
2. Abeer Abdullah Ogailan, M.Sc. (2017) Construction and initial characterization of yeast strains with Dyskeratosis congenita mutations. Supervisor: Dr. Ute Kothe

3. Muhammad Sajid Iqbal, Ph.D. (2017) Theoretical investigation of the kinetics and thermodynamics of conformational equilibrium in crowded medium. Supervisor: Dr. Marc Roussel
4. Reba-Jean Murphy, M.Sc. (2017) Stochastic modeling of the torpedo mechanism of eukaryotic transcription termination. Supervisor: Dr. Marc Roussel
5. Nirujah Balasingam, M.Sc. (2017) Elucidating the Role of Human OBG Like ATPase (HOLA1) in Apoptosis. Supervisor: Dr. Nehal Thakor
6. Divya Sharma, M.Sc. (2017) Characterizing the Interaction between PDCD4 and eIF3 with Respect to Translation Regulation. Supervisor: Dr. Nehal Thakor
7. Shahin Sowlati-Hashjin, Ph.D. (2018) Computational investigation of oxidative damage to guanine: formation, recognition and removal by DNA repair enzymes in humans and bacteria. Supervisor: Dr. Stacey Wetmore

Other research dissemination – >160

- >35 presentations by PIs
 - >19 of these presentations invited or keynote lectures
- >120 presentations by trainees (poster and oral presentations)

Funding

ARRTI Principal Investigators received approximately \$2.3 million in operating grants in 2016-17.

This includes:

- \$305,000 from the Natural Sciences and Engineering Research Council
- \$650,000 from the Canadian Foundation for Innovation
- \$200,000 from the Alberta Prion Research Institute
- \$50,000 from WorkSafe BC
- \$1,099,000 from Research Chairs
 - Dr. Stacey Wetmore – Canada Research Chair in Computational Chemistry
 - Dr. Athanasios Zovoilis – Canada Research Chair in RNA Bioinformatics and Genomics
 - Dr. HJ Wieden – Alberta Innovates Strategic Chair in RNA Bioengineering
 - Dr. Ute Kothe – Alberta Innovates Strategic Chair in Transcriptomics of RNA Modification
 - Dr. Nehal Thakor – Campus Alberta Innovation Program (CAIP) Chair of Synthetic Biology and RNA-based Systems
 - Dr. Trushar Patel – Canada Research Chair in RNA & Protein Biophysics

Also, >\$495,000 in funding was received from the following sources:

- >\$37,000 resource allocation from Compute Canada
- \$12,000 for events from CIHR and the RNA Society
- \$32,000 from geekStarter for the collegiate iGEM team
- \$379,058 in beamtime from Diamond Light Source Limited
- \$10,000 from the University of Calgary through the Calgary Clinical Research Fund
- \$25,000 from the Canadian Hepatitis C Network

In addition, >\$310,000 in funding was received by ARRTI students and postdoctoral fellows from NSERC, Alberta Innovates, the Alberta Government and the Canadian Hepatitis C Network.

This makes a total of >**\$3.1 million** in funding in the 2017-18 reporting year.

Note: The above list of funding may not be comprehensive, and indicates a minimum amount of funding for the reporting period.

Events

CAIP Research Showcase – Celebrating achievements and trainees (Standalone Activity)

- The Government of Alberta created the Campus Alberta Innovates Program (CAIP) in 2011 to attract national and international research talent to the province of Alberta. The University of Lethbridge, University of Calgary, University of Alberta, and Athabasca University recruited 19 CAIP Research Chairs focused on the priority research areas of Energy and Environment, Food and Nutrition, Neuroscience/Prions, and Water.
- On March 20-21, 2018, the University of Lethbridge hosted the first CAIP Research Showcase, which brought together CAIP Chairs from across Alberta, their trainees, members of government and representatives from Alberta Innovates to discuss the success and future of the CAIP program.
- **Dr. Nehal Thakor** was one of the primary organizers of this event, and his efforts led to this event being held at the University of Lethbridge.
- Keynote talks covered all four research priority areas, followed by panel discussions.
 - Water – Dr. Fred Wrona (Alberta’s Chief Scientist – Environmental Monitoring and Science)
 - Food and nutrition – Dr. Carla Prado (Director of the Human Nutrition Research Unit and CIHR New Investigator, University of Alberta)
 - Neuroscience and Prions – Dr. Roger A. Dixon (Director of Victoria Longitudinal Study, Professor and Canada Research Chair, University of Alberta)
 - Energy and Environment – Dr. David Bressler (Director, Biorefining Conversions Network, University of Alberta)
- A fourth keynote lecture was given by Laura Kilcrease, Chief Executive Officer of Alberta Innovates, about the future of Alberta Innovates.
- Posters were presented by trainees from local and external CAIP chairs, as well as other ARRTI trainees. Half of the 40 posters were presented by ARRTI trainees.

Alberta Virology Conference (Standalone Activity)

- The Alberta Virology Conference was held at the University of Alberta on June 1-2, 2017. ARRTI member, **Dr. Trushar Patel**, was a member of the organizing committee for this event.
- One major outcome of this conference was the publication of a special issue of the journal *Biotechnology and Genetic Engineering Reviews: Virology – Reviews from the frontline of the Alberta Virology Conference*. **Dr. Patel** was a guest editor of this issue.
- Of the eight peer-reviewed review articles in this issue, four were authored by ARRTI members.

Gairdner Student Outreach & Gairdner Lecture Program (Standalone Activity)

Keynote Speaker: Dr. Lewis Kay

- Dr. Lewis Kay is a recipient of the 2017 Canada Gairdner International Award for the development of modern NMR spectroscopy for studies of biomolecular structure dynamics and function, including applications to molecular machines and rare protein conformations.
- Dr. Kay is a Professor of molecular genetics, biochemistry and chemistry at the University of Toronto, and a Senior Scientist at the Hospital for Sick Kids in Toronto. He has been elected to the Royal Society of Canada, and the Royal Society (London, UK), and was inducted as an Officer in the Order of Canada in 2018. He received the Günther Laukien Prize in 2004, the Ontario Premier's Discovery award in 2008, and the Khorana Prize from the Royal Society of Chemistry (London, UK) in 2012. Since his Gairdner award in 2017, he was also received the Herzeberg Medal of the Natural Sciences and Engineering Research Council of Canada (2018).
- Dr. Kay's research has expanded our understanding of the flexible nature of protein structure and the importance of flexibility to both function and malfunction, which has led to new insights into what the key regions of molecules might be for drug targeting. The methods developed by Dr. Kay are used in labs around the world, including those researching illnesses such as diabetes, cancer and cardiovascular disease. The tools developed by his research group are disseminated freely and are extensively used worldwide.
- Dr. Kay's talk was titled "NMR Why Bother? Studies of the p97 Molecular Machine Provide an Answer."
- During his visit, Dr. Kay also gave a presentation at the Lethbridge Collegiate Institute high school, led a career development discussion at a graduate student luncheon, and viewed the annual Chinook Symposium.



Dr. Lewis Kay

11th Annual Chinook Symposium for Chemistry and Biochemistry (Annual Activity)

- Annual student conference hosted by the Department of Chemistry and Biochemistry at the University of Lethbridge to showcase student research.
- ARRTI member **Dr. Trushar Patel** was one of the organizers (with Susan Hill and Susan Findlay).
- ARRTI members **Dr. Mohamed Aboelnga, Dr. Brian Dempsey, Dr. Soumya Deo, Dr. Senthil Kailasam, Dr. Anne Rintala-Dempsey, and Dr. Govardhan Veerareddygar** were judges at the event.
- Of the 15 awards given, 10 were received by ARRTI trainees.

ARRTI Seminar Series (Ongoing Activity)

To foster a greater awareness of the research being conducted within the institute, members of ARRTI have participated in a monthly seminar series, where a member of each research group presented their research to members of the institute.

Average attendance: 36 attendees total, 4-6 PIs

ARRTI Speaker Series (Ongoing Activity)

In order to broaden the knowledge base of ARRTI members, a monthly speaker series has been established. The speaker series is intended to bring leading researchers to the University of Lethbridge for lectures on a broad range of topics relating to RNA research.

For the 2017-18 year, this series of events was funded by the RNA Salon initiative by the RNA Society, with additional funding by Lexogen.

This year's speaker series:

1. Dr. Igor Kovalchuk (May 9, 2017)
 - Department of Biological Sciences, University of Lethbridge
 - "Role of non-coding RNAs and non-coding RNA fragments in the regulation of genome stability and gene expression"
2. Dr. Ramon Grima (June 5, 2017)
 - School of Biological Sciences, University of Edinburgh
 - "Mean field theory of diffusion in heterogeneous intracellular crowded conditions"
3. Dr. Ian Lewis (June 19, 2017)
 - Department of Biological Sciences, University of Calgary
 - "Predicting disease from metabolites: the challenges and opportunities in state-of-the-art metabolomics"
4. Dr. Borries Demeler (August 4, 2017)
 - Department of Biochemistry, the University of Texas Health Science Center
 - "Measuring Interactions in the Solution Phase: Adding a Spectral Dimension to Analytical Ultracentrifugation"
5. Dr. Min-Xin Guan (September 1, 2017)
 - School of Medicine, Zhejiang University
 - "Mitochondrial tRNA mutations associated with hearing loss"
6. Dr. Andrea Gorrell (December 6, 2017)
 - Department of Biochemistry and Molecular Biology, University of Northern British Columbia
 - "*Haloarcula marismortui* Gene Expression Profiling Under Potassium Stress Conditions"
7. Dr. Richard Fahlman (December 13, 2017)
 - Department of Biochemistry, University of Alberta
 - "Non-Canonical Roles for the Translational Machinery in Proteostasis - Insights into Alternative Functions for tRNAs and Ribosomes in Gene Expression"
8. Dr. Carla Coffin (March 8, 2018)
 - Cumming School of Medicine, University of Calgary
 - "Hepatitis B Viral Persistence"



Average attendance: 40 attendees total, 5-8 PIs

Journal Club (Ongoing Activity)

Members of ARRTI participate in weekly journal club meetings, where members choose a work of contemporary scientific research to present to colleagues within the institute

Average attendance: 30 total attendees, 3-4 PIs

RiboClub Webconferences (Ongoing Activity)

Members of ARRTI participate in monthly RiboClub videoconferences. RiboClub is a pan-Canadian research association founded in Sherbrooke, Quebec, whose members study the evolution, structure and function of RNA. Each monthly videoconference has four presentations from researchers representing RNA laboratories across Canada.



Presentations by ARRTI members:

- **Luc Roberts** (Wieden): *IGR IRESs and the bacterial ribosome*
- **Emily Soon** (Kothe): *Transfer RNA methyltransferase TrmA is a dual-function enzyme that folds and modifies tRNA*
- **Dr. Joe Ross** (Thakor): *Eukaryotic initiation factor 5B (eIF5B) regulates apoptosis in glioblastoma cells via modulating expression of anti-apoptotic proteins*

Average attendance: 30 total attendees, 3-6 PIs

Webinars (Ongoing Activity)

Members of ARRTI have the option of attending webinars together in a classroom, and these webinars are therefore also made available to other interested parties at the University of Lethbridge.

1. Synthetic Biology: Life Redesigned (offered by Mathematical Biosciences Institute (MBI) Colloquium series) – September 20, 2017
2. The Challenge of Reproducibility in Biomedical Research (offered by Keystone Symposia) – November 8, 2017
3. CRISPR unleashed: New tools and applications in live-cell imaging (offered by Science) – November 29, 2017
4. Bioinformatics Series: Detecting Structural Variants (offered by Westgrid) – February 13, 2017

International Genetically Engineered Machine (iGEM) Competition (Ongoing Activity)

ARRTI trainees make part of the collegiate iGEM team, as well as acting as mentors and trainers for the Lethbridge high school team. In the 2017 Giant Jamboree, the high school team won a silver medal and the collegiate team won a gold medal. The collegiate team was also nominated for Best Integrated Human Practices, Best Education & Public Engagement and Best Software Tool, and received a Safety Commendation.



The collegiate team (Next Vivo) was working to develop a cell-free transcription and translation system that could bring synthetic biology to the masses. The high school team (SynthetINK) worked to express four different pigments in *E. coli* that could be used in a variety of applications, such as paint, printers and textiles.

Let's Talk Science (Ongoing Activity)

Dr. Ute Kothe serves as faculty supervisor for graduate student co-ordinators of Let's Talk Science, a national science outreach program. ARRTI trainee **Darren Gemmill** (undergraduate student in Wieden lab) is an LTS coordinator.

Let's Talk Science organized or participated in the following events:

1. Middle School Day (May 16, 2017) – Target audience: Middle school students (90 students involved)
2. Spooky Science Weekend (October 20-21, 2017) – Target audience: Elementary students (300 children attended)
3. Play Day (February 19, 2018) – Target audience: Families with children
4. Lethbridge Regional Science Fair and Science Olympics (March 24, 2018)
5. Let's DO Science Day (April 2018) – Target audience: High school students (60 students involved)



In addition to these events, LTS performed 47 school visits, offering a variety of chemistry, biology and physics experiments.

Media Coverage

“Sick people pass through them all the time, so how clean are our ambulances?” – Global News Lethbridge, May 26, 2017

- Interview with ARRTI alumnus, **Dr. Andy Hudson**, and collaborator at Lethbridge Fire and Emergency Services, Ward Egli, about ongoing project to assess microbial contamination in ambulances.

“iGEM team going green with printer ink” – Lethbridge Herald, Aug. 17, 2017

- Coverage of Lethbridge High School iGEM team's project of biologically-produced ink, with interviews with ARRTI trainees **Erin Kelly** and **Sydnee Calhoun**.

“Local iGEM teams advance to Giant Jamboree in Boston” – Lethbridge Herald, Oct. 17, 2017

- Coverage of both high school and collegiate team's success at the Alberta Genetically Engineered Machine competition in Edmonton, with interviews with ARRTI trainee **Taylor Sheahan** and **Dr. Hans-Joachim Wieden**.

“U of Lethbridge Teams Rock the iGEM Competitions - Again!” – Innovation Anthology, Nov. 29, 2017

- Interview with ARRTI trainee and iGEM student leader **Taylor Sheahan** about the teams' success at the Giant Jamboree.

“U of L iGEM teams shine at Boston” – Lethbridge Herald, Dec. 1, 2017

- Coverage of both high school and collegiate team’s success at the Giant Jamboree, with interviews with ARRTI trainee **Josh Friesen** and **Dr. Hans-Joachim Wieden**.

“Give Early Start for Synthetic Biology” – Innovation Anthology, Dec. 11, 2017

- Interview with **Dr. Hans-Joachim Wieden** about the benefits to integrating high school STEM training with iGEM and synthetic biology.

“Synthetic biology research profiled” – Lethbridge Herald, Dec. 12, 2017

- Coverage of article (*A synthetic biology approach to integrative high school STEM training*) published in Nature Biotechnology, with interview with **Dr. Hans-Joachim Wieden**.

“U of L student part of iGEM delegation” – Lethbridge Herald, Dec. 24, 2017

- Coverage of ARRTI trainee **Chris Isaac**’s role as an iGEM delegate who attended the Meeting of States Parties to the Biological Weapons Convention (BWC) in Geneva from Dec. 4 to 8, 2017.



“Researchers get grant to study Alzheimer’s disease” – Lethbridge Herald, Feb. 11, 2018

- Coverage of grant from Alberta Prion Research Institute for **Dr. Athan Zovoilis** and **Dr. Majid Mohajerani**.

“Talk at U of L to discuss research of hepatitis B virus” – Lethbridge Herald, Mar. 8, 2018

- Coverage of ARRTI Speaker Series lecture by **Dr. Carla Coffin** and her collaboration with **Dr. Trushar Patel**.

“University medical researchers bolstered by addition of Demeler” – Lethbridge Herald, Apr. 3, 2018

- Coverage of Canada 150 Research Chair Award and recruitment of **Dr. Borries Demeler**.

Facilities



SynBridge Maker-Space

SynBridge usage in the 2017-18 reporting year was very similar to the 2016-17 year (3,304 hours and 3,450 hours, respectively). We had a total of 37 users from 10 different research groups, as well as usage by the facility manager.

Details about SynBridge equipment and rates can be found on our website:

<http://www.uleth.ca/research/centres-institutes/alberta-rna-research-and-training-institute/synbridge-synthetic-biology-maker-space>

Mass Spectrometry Facility

The Mass Spectrometry Facility (Orbitrap Fusion™ Tribrid™ Mass Spectrometer) is operational and serves as a core facility at the University of Lethbridge. Our Mass Spectrometry Facility Manager (**Fan Mo**) processed and analyzed over 500 samples in the reporting year, for several different research groups on campus.

For more information about the facility and its fees, please visit our website:

<http://www.uleth.ca/research/centres-institutes/alberta-rna-research-and-training-institute/arri-mass-spectrometry-facility>

Notable Accomplishments

College of New Scholars, Artists and Scientists of the Royal Society of Canada

- Dr. Ute Kothe elected as a member

13th Annual RiboWest Conference Awards (Vancouver, British Columbia)

- Luc Roberts (Wieden) – 1st Place Graduate Poster
- Sarah Schultz (Kothe) – 2nd Place Graduate Poster
- Keiran Vanden Dungen (Thakor) – 1st Place Undergraduate Poster
- Elijah Dueck (Kothe) – 2nd Place Undergraduate Poster
- Dora Capatos (Wieden) – Travel Award
- Jeremy Quiroga (Patel) – Travel Award

11th Annual Chinook Symposium for Chemistry and Biochemistry (Lethbridge, Alberta)

- Cynthia Fonderson (Wetmore) – 1st Place Undergraduate Chemistry, Rookie of the Year
- Elijah Dueck (Kothe) – 1st Place Undergraduate Biochemistry, Canadian Journal of Chemistry Award for Best Student Presentation (Undergraduate Award)
- Keiran Vanden Dungen (Thakor) – 2nd Place Undergraduate Biochemistry
- Sarah Schultz (Kothe) – 1st Place MSc Biochemistry
- Chris Isaac (Zovoilis) – 2nd Place MSc Biochemistry
- Taylor Sheahan (Wieden) – 1st Place PhD Biochemistry
- Luc Roberts (Wieden) – 2nd Place PhD Biochemistry
- Ryan Kung (Wetmore) – 1st Place PhD Chemistry

Spring Convocation 2017 (University of Lethbridge)

- School of Graduate Studies Medal of Merit, Doctor of Philosophy – Laura Keffer-Wilkes (Kothe)

Canada Hepatitis C Network Postdoctoral Fellowship

- Vanessa Meier-Stephenson (Patel)

Emerging Leaders in Biosecurity Fellowship at the Johns Hopkins Center for Health Security

- Chris Isaac (MSc student, Zovoilis)

Alberta Innovates – Technology Futures (AITF) Graduate Student Scholarship

- Taylor Sheahan (PhD student, Wieden)

Alberta Innovates Len Bolger Memorial Scholarship for Energy Research Excellence

- Taylor Sheahan (PhD student, Wieden)

NSERC Postgraduate Scholarships

- Taylor Sheahan (PhD student, Wieden)
- Ryan Kung (PhD student, Wetmore)
- Erin Kelly (MSc student, Kothe)

Canada Graduate Scholarships – Michael Smith Foreign Study Supplement

- Stefan Lenz (PhD student, Wetmore)

Government of Alberta Queen Elizabeth II Scholarship

- Erin Kelly (Kothe)
- Elijah Dueck (Kothe)

NSERC University Undergraduate Student Research Awards

- Lindey Felske (Wetmore)
- Tim Vos (Kothe)
- Anileen Pageni (Kothe)

Alberta Innovates – Health Solutions (AIHS) Summer Studentship

- Daniel Rocca (Undergraduate student, Wieden)
- Elijah Dueck (Undergraduate student, Kothe)

Canadian Institutes of Health Research – summer Studentship Award

- Olivia Marasco (Undergraduate student, Thakor and Roussel)

University of Lethbridge – Chinook Summer Research Awards

- Keara Cheradaryk (Undergraduate student, Kothe)
- Justin Olsen (Undergraduate student, Thakor)

Alberta Innovates Heritage Youth Researcher Summer (HYRS)

- Justin Bly (Kothe)
- Michael Kindley (Wieden)

