

Ian Israel Cardle

icardle@uw.edu | www.linkedin.com/in/iانcardle | [Google Scholar](#)

EDUCATION

University of Washington, College of Engineering & UW Medicine, Seattle, WA Dec. 2022

Doctor of Philosophy in Bioengineering • Cumulative GPA: 3.92

Molecular and Cellular Engineering Concentration

Thesis Advisors: Dr. Suzie Pun, Dr. Michael Jensen (co-advised)

Dissertation: *Aptamers & Peptides - Finding & Guiding CAR T Cells for Better Cancer Care.*

Cornell University, College of Agriculture and Life Sciences, Ithaca, NY May 2016

Bachelor of Science in Biological Engineering • Cumulative GPA: 3.91

Biomedical Engineering Concentration

Dyson Business Minor for Engineers • Minor GPA: 4.0

RESEARCH EXPERIENCE

Postdoctoral Scholar in Pun Macromolecule Drug Discovery and Delivery Lab Dec. 2022 – Present

Department of Bioengineering, University of Washington, Seattle, WA

Graduate Research Assistant in Pun Macromolecule Drug Discovery and Delivery Lab Sept. 2016 – Dec. 2022

Department of Bioengineering, University of Washington, Seattle, WA

Graduate Research Assistant in Jensen Therapeutics Innovation Core Sept. 2016 – Dec. 2022

Academic Lab, Seattle Children's Therapeutics, Seattle, WA

- Evaluated panel of anti-fluorescein chimeric antigen receptor (CAR) T cells directed by folate-FITC, a bispecific adaptor molecule that targets FOLR1 on solid cancers, which helped kickstart the ENLIGHTen-01 clinical trial.
- Investigated CD8- and transferrin receptor 1-binding DNA aptamers as inexpensive cell sorting reagents in CAR T-cell therapy manufacturing (sponsored research agreement with Juno Therapeutics, a Bristol Myers Squibb company).
- Designed tumor-targeting aptamers and peptides with enhanced pharmacological traits for *in vivo* translation.
- Established a novel, universal CAR T-cell platform that covalently interfaces with synthetic, bifunctional aptamer and peptide intermediates for therapeutic cancer targeting.
- Mentored undergraduate, master's, and graduate rotation students on several research projects.

Undergraduate Researcher in Kirby Micro/NanoFluidics Laboratory Oct. 2013 – Aug. 2016

Sibley School of Mechanical and Aerospace Engineering, Cornell University, Ithaca, NY

- Characterized chemoresistance and the epithelial-to-mesenchymal transition (EMT) in pancreatic cancer cell lines used to model circulating tumor cells (CTCs) and optimized the lab's microfluidic immunocapture device for improved detection of these phenotypically diverse cells.

Intern in Inflammatory and Immune Disease Department June – Aug. 2015

Target Discovery, Regeneron Pharmaceuticals Inc., Tarrytown, NY

- Developed an assay for visualizing NF- κ B nuclear translocation in T cells with Amnis Imaging Flow Cytometry to assess in-house immuno-oncology drugs.
- Uncovered expression kinetics of immune checkpoint targets in activated T cells to identify the testing window with engineered accessory cells and soluble antibodies.

Research Assistant in L. Picker Primate HIV Vaccination Lab June – Aug. 2014

OHSU Vaccine and Gene Therapy Institute, ONPRC, Beaverton, OR

- Isolated immune cell populations from rhesus macaque whole blood, tissue, and bronchoalveolar lavage samples to measure viral load and intracellular cytokines over vaccination and simian immunodeficiency virus infection course.
- Collected tissue and organ samples during necropsies for RNA and cytokine analysis.

Intern in R. Nelson Maize Quantitative Disease Resistance Lab May – Aug. 2013

Department of Plant Pathology, Cornell University, Ithaca, NY

- Conducted CTAB DNA extractions and SNP PCR on maize leaf samples.
- Assisted in the planting, weeding, inoculation, incubation period scoring, flowering time scoring, and tissue collection of that year's multi-acre maize crop.
- Set up and took down cross-pollinations for future seed stock.

LEADERSHIP POSITIONS

Co-Head, Immunology Journal Club (Immunoclub), University of Washington	Feb. 2019 – Apr. 2020
Grader/TA, Systems Immunology and Immunoengineering, University of Washington	Mar. – June 2020
Managing Editor, <i>Denatured</i> Student-Run Science Journal, University of Washington	Sept. 2017 – May 2018
Career Development Chair, Institute of Biological Engineering, Cornell University	Aug. 2013 – May 2015
TA, Fluid Mechanics, Cornell University	Aug. – Dec. 2015

SKILLS

Lab: mammalian and bacterial cell culture and cloning • lentivirus production and transduction • SELEX • PBMC isolation • MACS • CAR T-cell manufacturing • flow cytometry • immunofluorescence imaging • western blotting • MTT assays • nucleofection • chromium release cytotoxicity assays • cytokine release assays • bio-layer interferometry • solid-phase peptide synthesis • HPLC • MALDI • bioconjugation • animal handling, injections, bleeding, and imaging

Software: FlowJo • GraphPad Prism • ImageJ • Inkscape • Microsoft Office Suite

AWARDS AND HONORS

Cornell University

Dean's List (7 semesters)	Aug. 2012 – Dec. 2015
Alfred & Evelyn Longhouse Scholarship	Aug. 2013 – May 2016
Engineering Learning Initiatives (ELI) Research Award	Jan. 2014
Alpha Epsilon BEE Honor Society	Sept. 2014
Burton A. Jennings Memorial Scholarship	Aug. 2015 – May 2016
Golden Key International Honour Society	Dec. 2015
Magna Cum Laude, Cornell University	May 2016

University of Washington

ARCS Foundation Fellowship	Sep. 2016 – Sep. 2018
Cable Fellowship	Oct. 2016
Interdisciplinary Training in Cancer Research NIH Training Grant	Dec. 2017 – Aug. 2019
OTS 2018 Annual Meeting Poster Award	Oct. 2018
OTS Paper of the Month	June 2019
NSF GRFP Fellowship	Sept. 2019 – Sept. 2022

PUBLICATIONS (*authors contributed equally)

- Cheng, E.L.*, **Cardle, I.I.***, Kacherovsky, N.*, Bansia, H.*, Wang, T.*, Zhou, Y., Raman, J., Yen, A., Gutierrez, D., Salipante, S.J., des Georges, A., Jensen, M.C., Pun, S.H. Discovery of a Transferrin Receptor 1-Binding Aptamer and Its Application in Cancer Cell Depletion for Adoptive T-Cell Therapy Manufacturing. *Journal of the American Chemical Society*. 144(30), 13851-13864 (2022).
- Thege, F.I., **Cardle, I.I.**, Gruber, C.N., Siemann, M.J., Cong, S., Wittmann, K., Love, J., Kirby, B.J. Acquired chemoresistance drives spatial heterogeneity, chemoprotection and collective migration in pancreatic tumor spheroids. *PLOS ONE*. 17(5), e0267882 (2022).
- Kacherovsky, N.*, Yang, L.F.*, Dang, H.V.*, Cheng, E.L., **Cardle, I.I.**, Walls, A.C., McCallum, M., Sellers, D.L., DiMaio, F., Salipante, S.J., Corti, D., Veesler, D., Pun, S.H. Discovery and Characterization of Spike N-Terminal Domain-Binding Aptamers for Rapid SARS-CoV-2 Detection. *Angewandte Chemie*. 133(39), 21381-21385 (2021).
- **Cardle, I.I.**, Jensen, M.C., Pun, S.H., Sellers, D.L. Optimized serum stability and specificity of an $\alpha\text{v}\beta 6$ integrin-binding peptide for tumor targeting. *Journal of Biological Chemistry*. 296, 100657 (2021).
- **Cardle, I.I.***, Cheng, E.L.*, Jensen, M.C., & Pun, S.H. Biomaterials in Chimeric Antigen Receptor T-Cell Process Development. *Accounts of Chemical Research*. 53(9), 1724-1738 (2020).
- Kacherovsky, N.*, **Cardle, I.I.***, Cheng, E.L., Yu, J.Y., Baldwin, M.L., Salipante, S.J., Jensen, M.C., & Pun, S.H. Traceless aptamer-mediated isolation of CD8⁺ T cells for chimeric antigen receptor T-cell therapy. *Nature Biomedical Engineering*. 3, 783-795 (2019).
- Thege, F.I., Gruber, C.N., **Cardle, I.I.**, Cong, S.H., Lannin, T.B., Kirby, B.J. anti-EGFR capture mitigates EMT- and chemoresistance-associated heterogeneity in a resistance-profiling CTC platform. *Analytical Biochemistry*. 577, 26-33 (2019).
- Lu, J., Chu, H., Wheeler, L.W., Nelson, M., Westrick, E., Matthaei, J.F., **Cardle, I.I.**, Johnson, A., Gustafson, J., Parker, N., Vetzl, M., Xu, L., Wang, E.Z., Jensen, M.C., Klein, P.J., Low, P.S., Leamon, C.P. Preclinical Evaluation of Bispecific Adaptor Molecule Controlled Folate Receptor CAR-T Cell Therapy with Special Focus on Pediatric Malignancies. *Frontiers in Oncology*. 9, 151 (2019).

-
- Olden, B.R., Perez, C.R., Wilson, A.L., **Cardle, I.I.**, Lin, Y., Kaehr, B., Gustafson, J.A., Jensen, M.C., & Pun, S.H. Cell-Templated Silica Microparticles with Supported Lipid Bilayers as Artificial Antigen-Presenting Cells for T Cell Activation. *Advanced Healthcare Materials*. 8, 1801188 (2018).
 - Lannin, T.B., Su, W.W., Gruber, C.N., **Cardle, I.I.**, Huang, C.C., Thege, F.I., & Kirby, B.J. Automated Electrorotation Shows Electrokinetic Separation of Pancreatic Cancer Cells Is Robust to Acquired Chemotherapy Resistance, Serum Starvation, and EMT. *Biomicrofluidics*. 10(6), 064109 (2016).

POSTERS/PRESENTATIONS

- **Cardle, I.I.**, Kacherovsky, N., Cheng, E.L., Yu, J.L., Baldwin, M.L., Salipante, S.J., Jensen, M.C., Pun, S.H. Traceless Isolation of CD8⁺ T Cells by Reversible, Aptamer-Based Selection for CAR T Cell Therapy. *Oligonucleotide Therapeutics Society Annual Meeting*. Seattle, WA (2018).
- **Cardle, I.I.**, Brendel, M.B., Thege, F.I., Kirby, B.J. Optimization of Microfluidic Immunocapture of Endothelial Progenitor Cells (EPCs) as a Tool for Breast Cancer Relapse Prediction. *Cornell BioExpo*. Ithaca, NY (2015).
- **Cardle, I.I.**, Godla, M.E., Thege, F.I., Kirby, B.J. Circulating Tumor Cells: Flow Cytometric Immunocharacterization of Candidate Surface Antigens for Early Detection of Ovarian Cancer. *CURB Spring Forum*. Ithaca, NY (2014).

PATENTS

- Sellers, D., **Cardle, I.I.** Universal chimeric antigen receptor T cell. U.S. Provisional Patent Application 63/379,624, filed October 14, 2022. Patent pending.
- Pun, S.H., Kachervosky, N., Cheng, E.L., **Cardle, I.I.**, Jensen, M.C. Compositions and methods related to transferrin receptor-binding aptamers. U.S. Patent Application 17/813,021, filed July 15, 2022. Patent pending.
- Pun, S.H., Sylvestre, M., Kacherosky, N., Cheng, E.L., **Cardle, I.I.**, Saxby, C. Monocyte and macrophage binding aptamers and their application. U.S. Patent Application 17/849,513, filed June 24, 2022. Patent pending.
- Sellers, D., **Cardle, I.I.**, Pun, S.H. Engineered peptides for avb6 integrin binding and related methods of use and synthesis. International Patent Application PCT/US2022/024095, filed April 8, 2022. Patent pending.
- Pun, S.H., Jensen, M.C., Kacherovsky, N., **Cardle I.I.** Compositions and methods related to aptamer-based reversible cell selection. International Patent Application PCT/US2019/042063, filed July 16, 2019. Patent pending.