Ian Israel Cardle
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EDUCATION

University of Washington, College of Engineering & UW Medicine, Seattle, WA — September 2016 - Present
Doctor of Philosophy in Bioengineering, expected 2022 • 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 to Better Cancer Care.*

Cornell University, College of Agriculture and Life Sciences, Ithaca, NY — August 2012 – 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

Graduate Research Assistant in Pun Macromolecule Drug Discovery and Delivery Lab — September 2016 – Present
Department of Bioengineering, University of Washington, Seattle, WA

- Selecting DNA aptamers specific to T cells and tumor antigens using systemic evolution of ligands by exponential enrichment (SELEX).
- Validating affinity and target specificity of selected aptamers using multiple assays.
- Modifying aptamers for improved affinity, stability, and biodistribution.
- Using aptamers as traceless isolation reagents in chimeric antigen receptor (CAR) T-cell production and tumor-targeting intermediates in current, universal CAR T-cell methods.
- Designing, synthesizing, and evaluating tumor-targeting bifunctional peptide intermediates in novel, universal CAR T-cell methods.
- Mentoring an undergraduate student towards an independent research project.

Graduate Research Assistant in Jensen Therapeutics Innovation Core — January 2017 – Present
Research and Development, Seattle Children's Therapeutics, Seattle, WA

- Cloning plasmids and producing and titering lentivirus for CAR T-cell production.
- Isolating, activating, transducing, expanding, and characterizing CAR T cells *ex vivo.*
- Assessing *in vitro* anti-tumor functionality of universal CAR T cells with aptamer and peptide targeting intermediates developed in the Pun Lab.

Researcher at Kirby Research Group's Micro/NanoFluidics Laboratory — October 2013 – August 2016
Sibley School of Mechanical and Aerospace Engineering, Cornell University, Ithaca, NY

- Evaluated mechanism of chemotherapeutic resistance and its propagation in gemcitabine-resistant pancreatic cancer cells using MTT and western blot assays.
- Characterized the epithelial-to-mesenchymal transition (EMT), a process proposed to underlie metastasis, in pancreatic cancer cells.
- Identified novel surface antigens to serve as more robust immunocapture targets of EMT-like and chemoresistant circulating tumor cells (CTCs), cells with significant diagnostic and drug screening value that escape current capture platforms.
- Functionalized lab's geometrically enhanced differential immunocapture (GEDI) microfluidic chip with antigen-specific antibodies and quantified CTC immunocapture.

Intern in Regeneron's Inflammatory and Immune Disease Department — June – August 2015
Target Discovery, Regeneron Pharmaceuticals Inc., Tarrytown, NY

- Developed an assay for visualizing NF-κB 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.
- Delivered research results to over a hundred employees and the department head as part of a selected group of interns in an end-of-summer presentation series.

Research Assistant at OHSU's L. Picker Primate HIV Vaccination Lab June – August 2014
OHSU Vaccine and Gene Therapy Institute, ONPRC, Beaverton, OR

- Isolated relevant 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 (SIV) infection course.
- Collected tissue and organ samples during necropsies for RNA and cytokine analysis.

Intern in R. Nelson Maize Quantitative Disease Resistance Lab May – August 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 — February 2019 – Present
Grader/TA, Systems Immunology and Immunoengineering, University of Washington — March 2020 – June 2020
Managing Editor, *Denatured* Student-Run Science Journal, University of Washington — September 2017 – May 2018
Career Development Chair, Institute of Biological Engineering, Cornell University — August 2013 – May 2015
TA, Fluid Mechanics, Cornell University — August 2015 – December 2015

SKILLS

Lab: mammalian and bacterial cell culture and cloning • lentivirus production and transduction • SELEX • Ficoll isolation of PBMCs • T cell isolation and CAR T cell manufacturing • flow cytometry • immunofluorescence imaging • confocal microscopy • western blotting • MTT assays • nucleofection • chromium release cytotoxicity assays • cytokine release assays • bio-layer interferometry • solid-phase peptide synthesis • HPLC • MALDI

Software: FlowJo • Prism • Matlab • ImageJ • IDEAS • Microsoft Office Suite • Inkscape

AWARDS AND HONORS

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

University of Washington
ARCS Foundation Fellowship — September 2016 – September 2018
Cable Fellowship — October 2016
Interdisciplinary Training in Cancer Research NIH Training Grant — December 2017 – August 2019
OTS 2018 Annual Meeting Poster Award — October 2018
NSF GRFP Fellowship — September 2019 – September 2022

PUBLICATIONS

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., Vetzel, 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).
**authors contributed equally*

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

Pun, S.H., Jensen, M.C., Kacherovsky, N., **Cardle I.I.** Compositions and methods related to aptamer-based reversible cell selection. Publication Number WO2020018578 (published 1/23/2020). US Patent Applications 62/699,438 (filed 7/17/2018) & 62/779,946 (filed 12/14/2018).