

# ELIZABETH I. CASH

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## CURRENT POSITION

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<b>University of California, Berkeley</b> Postdoctoral Scholar	Berkeley, CA August 2016 - Present
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## EDUCATION

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<b>Arizona State University</b> PhD, Biology Dissertation: Proximate and ultimate mechanisms of nestmate recognition in ants Advisors: Jürgen Gadau (committee chair) & Jürgen Liebig Committee: Jennifer Fewell, Bert Hölldobler, & Kenro Kusumi	Tempe, AZ 2016
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<b>The Ohio State University</b> BSc, <i>cum laude</i> , Biology Independent Research: The function of pheromones in socially parasitic <i>Lasius</i> ants Advisors: Joseph Raczkowski, Steven Rissing, & John Wenzel	Columbus, OH 2009
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<b>University of Cincinnati</b> Foundation Coursework, Design	Cincinnati, OH 1999
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## RESEARCH EXPERIENCE AND TRAINING

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<b>University of California, Berkeley</b> Postdoctoral Scholar; Advisor: Neil D. Tsutsui Evolution of desiccation resistance and colony recognition in Argentine ants	Berkeley, CA August 2016 - Present
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<b>Arizona State University</b> Graduate Research Associate; Advisor: Jürgen Gadau Acyl-CoA desaturase gene family evolution and function in ants	Tempe, AZ 2009 - 2016
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<b>Ant Course</b> Participant; Field course on ant collection, identification, and curation	Portal, AZ 2015
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<b>University of Würzburg / Arizona State University</b> Participant; International symposium and workshop on frontiers in insect biology	Würzburg, Germany 2014
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<b>Smithsonian Tropical Research Institute / Arizona State University</b> Participant; Tropical Field Biology course	BCI, Panama 2011
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<b>The Ohio State University</b> Laboratory Assistant; Advisors: Joseph Raczkowski, Steven Rissing, & John Wenzel Behavioral and chemical ecology of social parasitism in <i>Lasius</i> ants	Columbus, OH 2007 - 2009
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## PEER-REVIEWED PUBLICATIONS

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**Cash E**, Tsutsui N, and Smith A (in preparation) The evolution of acyl-CoA desaturase genes in *Odontomachus* trap-jaw ants.

**Cash E**, Setayesh A, and Tsutsui N (in preparation) Antimicrobial properties of a multifunctional, Argentine ant pheromone.

**Cash E**, Liebig J, and Gadau J (in preparation) The ontogeny of nestmate recognition cues in the red harvester ant, *Pogonomyrmex barbatus*.

**Cash E** and Gadau J (in preparation) Contextualizing combat: the effects of prior experience, cuticular hydrocarbons, and seasonality on nestmate recognition behavior in the red harvester ant, *Pogonomyrmex barbatus*.

Oeyen JP, Benoit JB, Beukeboom L, Bornberg-Bauer E, Buttstedt A, Calevro F, **Cash E** (7/84 authors), ...and Niehuis O (under review) Draft genomes of two sawflies reveal evolutionary acquisitions that fostered the megaradiation of parasitoid and eusocial Hymenoptera.

Buellesbach, J, Whyte B, **Cash E**, Gibson JD, Scheckel KJ, Sandidge R, and Tsutsui N (2018) Desiccation resistance and micro-climate adaptation: cuticular hydrocarbon signatures of different Argentine ant supercolonies across California. *Journal of Chemical Ecology* 44: 1101–1114.

**Cash E**<sup>†</sup>, Helmkampf M<sup>†</sup>, and Gadau J (2015) Evolution of the insect desaturase gene family with an emphasis on social Hymenoptera. *Molecular Biology and Evolution* 32: 2366–2372. <sup>†</sup>These authors contributed equally to this work.

Simola DF, Wissler L, Donahue G, ...**Cash E** (18/38 authors), ...and Gadau J (2013) Social insect genomes exhibit dramatic evolution in gene composition and regulation while preserving regulatory features linked to sociality. *Genome Research* 23: 1235–1247.

Gibson JD, Niehuis O, Peirson BRE, **Cash E**, and Gadau J (2013) Genetic and developmental basis of F2 hybrid breakdown in *Nasonia*. *Evolution* 67: 2124–2132.

Smith CR, Smith CD, Robertson HM, ...**Cash E** (11/45 authors), ...and Gadau J (2011) A draft genome of the red harvester ant, *Pogonomyrmex barbatus*: a model for reproductive division of labor and social complexity. *Proceedings of the National Academy of Sciences of the United States of America* 108: 5667–5672.

Smith CD, Zimin A, Holt C, ...**Cash E** (6/50 authors), ...and Tsutsui ND (2011) The draft genome of the globally widespread and invasive Argentine ant (*Linepithema humile*). *Proceedings of the National Academy of Sciences of the United States of America* 108: 5673–5678.

Suen G, Teiling C, Li L, ...**Cash E** (9/49 authors), ...and Currie CR (2011) The genome sequence of the leaf-cutter ant *Atta cephalotes* reveals insights into its obligate symbiotic lifestyle. *PLoS Genetics* 7: e1002007.

## BOOK CHAPTERS

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Buellesbach, J, **Cash E**, and Schmitt T (2018) Communication, Insects. In Swanson P and Skinner MK (Eds.), *Encyclopedia of Reproduction*, 2nd Edition, Volume 6: Comparative Reproduction (pp. 78–83). Academic Press. <https://doi.org/10.1016/B978-0-12-809633-8.20539-6>

## SCIENTIFIC PRESENTATIONS

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**Cash E.** 5th March 2019. Citizen Science can be an Extraordinary Gateway to STEM Learning and Engagement! (Invited Panelist) *Coalition for Education & Outreach*, University of California, Berkeley, CA.

**Cash E.** 9th August 2018. Functional genetic study of chemical recognition systems in Argentine ants. (Oral Presentation) *XVIIIth Congress of IUSSI*, Guarujá, SP, Brazil.

**Cash E.** 6th February 2018. Ant societies: studies of genetic and environmental influences on colony identity. (Invited Speaker) *Eco/Evo Seminar*, Stanford University, Stanford, CA.

**Cash E.** 17th March 2017. The evolution of nestmate recognition and the ontogeny of territoriality in ants. (Invited Speaker) *Essig Museum Seminar*, Berkeley, CA.

**Cash E** and Gadau J. 27th September 2016. Contextualizing combat: the effects of prior experience, cuticular hydrocarbons, and seasonality on territorial aggression in the red harvester ant, *Pogonomyrmex barbatus*. (Oral Presentation) *International Congress of Entomology*, Orlando, FL.

**Cash E** and Gadau J. 6th December 2015. The effects of non-nestmate experience and familiarity on territorial aggression in red harvester ants. (Oral Presentation) *ASU-UWü International Symposium and Workshop on Frontiers in Insect Biology*, Arizona State University, Tempe, AZ.

**Cash E** and Gadau J. 25th October 2015. Genetics and gestalt: the grapples with understanding ant recognition. (Oral Presentation) *3<sup>rd</sup> International Meredith Gould Conference*, CICESE, Ensenada, Mexico.

**Cash E**, Helmkampf M, and Gadau J. 3rd May 2015. Genomic and genetic patterns of desaturase gene functional variation in ants. (Oral Presentation) *Biology & Genomics of Social Insects*, Cold Spring Harbor Laboratory, NY.

**Cash E** and Gadau J. 17th November 2014. Developing the Gestalt: Nestmate recognition cues in the red harvester ant, *Pogonomyrmex barbatus*. (Poster Presentation) *62<sup>nd</sup> annual Entomological Society of America meeting*, Portland, OR.

**Cash E**, Helmkampf M, and Gadau J. 24th May 2014. Evolution of desaturases in ants. (Oral Presentation) *ASU - UWü International Symposium and Workshop on Frontiers in Insect Behavior, Social Organization, and Evolution*. Würzburg, Germany.

**Cash E**, Helmkampf M, and Gadau J. 13th November 2013. The evolution of desaturase genes in ants. (Oral Presentation) *61<sup>st</sup> annual Entomological Society of America meeting*, Austin, TX.

**Cash E** and Gadau J. 13th November 2013. Nasty neighbors: The effect of cuticular hydrocarbons and prior experience on nestmate recognition behavior in the red harvester ant, *Pogonomyrmex barbatus*. (Poster Presentation) *61<sup>st</sup> annual Entomological Society of America meeting*, Austin, TX.

**Cash E**, Helmkampf M, and Gadau J. 18th March 2012. Capturing That Air of Distinction: Desaturase gene diversity as a contributor to nestmate recognition in seven newly sequenced ant species. (Oral Presentation) *Gordon Research Seminar on Genes & Behavior*, Galveston, TX.

**Cash E**, Helmkampf M, and Gadau J. 20th June 2011. Uncovering the genetic basis of colony recognition: desaturase gene diversity in seven newly sequenced ant species. (Poster Presentation) *Evolution Meeting*, Norman, OK.

## SCIENTIFIC PRESENTATIONS (CONTINUED)

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**Cash E**, Helmkampf M, and Gadau J. 20th June 2010. The genetic basis of colony recognition: desaturase genes in the newly sequenced genomes of *Pogonomyrmex barbatus* and *Linepithema humile*. (Poster Presentation) *Fourth Annual Arthropod Genomics Symposium*, Kansas City, MO.

**Cash E**, Raczkowski J, and Rissing S. 13th May 2009. The function of pheromones in worker ants: the parasitism of *Lasius alienus* by *Lasius claviger*. (Poster Presentation) *The Richard J. and Martha D. Denman Undergraduate Research Forum*, Ohio State University, Columbus, OH.

**Cash E** and Harder J. 2nd December 2008. Comparison of annual changes in arthropod abundance and diversity in a central Ohio oldfield community. (Oral Presentation) *Conservation Biology*, Ohio State University, Columbus, OH.

## FELLOWSHIPS, GRANTS, AND AWARDS

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<b>NAS-IUSSI / USDA, Conference Travel Grant</b>	2018
Awarded funding to present research at the XVIIIth Congress of IUSSI	
<b>Graduate College Dissertation Fellowship</b>	2015 - 2016
Arizona State University: awarded funding for final year of dissertation research	
<b>School of Life Sciences, Graduate Training Fellowship</b>	2015
Arizona State University: awarded funding to receive training at the Ant Course	
<b>President's Prize, 2<sup>nd</sup> place in Graduate Student Poster Competition</b>	2014
62 <sup>nd</sup> Annual Meeting   Entomological Society of America	
<b>School of Life Sciences, Conference Travel Grant</b>	2014
Arizona State University: awarded funding to present research at the 62 <sup>nd</sup> annual meeting of the Entomological Society of America	
<b>School of Life Sciences, Graduate Excellence Award</b>	2014 – 2015
Arizona State University: awarded funding for graduate achievements	
<b>School of Life Sciences, Graduate Research Scholarship</b>	2013 – 2015
Arizona State University: awarded funding for graduate research	
<b>NAS-IUSSI, Conference Travel Grant</b>	2013
Awarded funding to present research at the 61 <sup>st</sup> annual meeting of the Entomological Society of America	
<b>School of Life Sciences, University Graduate Fellowship</b>	2012 – 2013
Arizona State University: awarded funding for graduate research	
<b>School of Life Sciences, Study Abroad Scholarship</b>	2010
Arizona State University: awarded funding to attend a tropical field biology course at the Smithsonian Tropical Research Institute	
<b>School of Life Sciences, Conference Travel Grant</b>	2010
Arizona State University: awarded funding to present research at the 4 <sup>th</sup> annual Arthropod Genomics Symposium	

## FELLOWSHIPS, GRANTS, AND AWARDS (CONTINUED)

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**Denman Undergraduate Research Forum, 3<sup>rd</sup> place in Biological Sciences** 2009  
The Ohio State University: awarded for undergraduate research poster presentation and invited to join the scientific research society, Sigma Xi

**Center for Life Sciences Education, National SMART Grant** 2007 - 2009  
The Ohio State University: awarded for academic achievement in biology

## TEACHING AND MENTORSHIP EXPERIENCE

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**University of California, Berkeley | Teaching** **Berkeley, CA**  
Guest Lecturer, Insects and Human Society (ESPM 40) Spring 2018 & 2019  
Guest Speaker, Mol. Approaches to Envir. Problem Solving (ESPM C192) Spring 2018 & 2019  
Guest Lecturer, Insect Behavior (ESPM 142) Fall 2016

**University of California, Berkeley | Research Mentorship** **Berkeley, CA**  
Ali Setayesh (Molecular & Cellular Biology Undergraduate) Spring 2017 - Present  
Emily Kinnaman (Molecular Environmental Biology Undergraduate) Spring 2019 - Present  
Skyler Anderson (Molecular Environmental Biology Undergraduate) Spring 2019 - Present  
Emily Takeuchi (Integrative Biology Undergraduate) Fall 2016 - Spring 2017

**Arizona State University | Teaching** **Tempe, AZ**  
Biomimicry Consultant, InnovationSpace (IND 464 & 465) Fall 2015 - Spring 2016  
Lecture Teaching Assistant, Organic Evolution (BIO 345) Summer 2013, 2014, 2015, & 2016  
Biomimicry Instructor, InnovationSpace (IND 464 & 465) Spring 2013 - Spring 2015  
Laboratory Teaching Assistant, General Biology II (BIO 182) Spring 2012  
Laboratory Teaching Assistant, General Entomology (BIO 386) Fall 2011 & 2012  
Laboratory Teaching Assistant, General Biology I (BIO 181) Spring 2011  
Lecture Teaching Assistant, General Genetics (BIO 340) Fall 2010  
Laboratory Teaching Assistant, Introductory Biology (BIO 100) Fall 2009

**Arizona State University | Research Mentorship** **Tempe, AZ**  
David Contreras (Genetics Undergraduate) Spring 2015 - Spring 2016  
Marie-Luise Hagitte (International Student-Intern) Fall 2015  
Katherine Fowler (Genetics Undergraduate) Spring - Summer 2015  
Rafael Testai\* (Genetics Undergraduate) Fall 2013 - Spring 2014  
Harry Grissom<sup>†</sup> (Biology Undergraduate) Fall 2012 - Summer 2013  
Anna-Lena Roll (International Student-Intern) Summer 2012  
Chad Allen (Biology Undergraduate) Spring 2012  
Bita Vaghari<sup>†</sup> (Biology Undergraduate) Fall 2010 - Spring 2011  
Lakshmi Ghanta<sup>†</sup> (Biology Undergraduate) Fall 2009 - Spring 2010

\*Students who successfully completed honor's thesis research.

<sup>†</sup>Students who continued in graduate research or professional school.

## PROFESSIONAL SOCIETIES

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International Union for the Study of Social Insects (IUSSI) 2013 - Present  
The Society for the Study of Evolution (SSE) 2011 - Present  
Association for Women in Science (AWIS) 2010 - Present  
The Entomological Society of America (ESA) 2010 - Present  
The National Society of Collegiate Scholars (NSCS) 2005 - Present

## REVIEWER / REFEREE

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*Biological Invasions, Comparative Biochemistry and Physiology - Part B: Biochemical and Molecular Biology, International Journal of Molecular Sciences, PLOS ONE, Revista Brasileira de Entomologia, Scientific Reports*

## OTHER PROFESSIONAL EXPERIENCE

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### Graphic and Web Design 2012 – Present

*California Pools Project* (UCB, 2016) <http://www.backyardbiodiversity.org/pools.html>  
*Tsutsui Lab Website* (UCB, 2016) <https://nature.berkeley.edu/tsutsuilab/>  
*Arizona Beekeepers Association* (ASU, 2015) <http://www.elizabethcash.com/azbeekeepers.html>  
*The Biomimicry Center* (ASU, 2015) <http://www.elizabethcash.com/biomimicry.html>  
*I heart ants & I heart bees* (ASU, 2014) <http://www.elizabethcash.com/iheartants.html>  
*SIRG & friends* (ASU, 2013) <http://www.facebook.com/SIRG.ASU>  
*Gadau Lab Website* (ASU, 2012) <http://gadau.lab.asu.edu/>

### Photography 2011 – Present

*Breakthroughs* (UCB, 2019) in press  
*Philosophical Transactions B* (Royal Society, 2019) <https://doi.org/10.1098/rstb.2018.0193>  
*The Berkeley Science Review* (UCB, 2018) <http://berkeleysciencereview.com/article/ant-speak/>  
*Biomimicry Center* (ASU, 2015) <http://asunews.asu.edu/20150306-biomimicry-center-asu-launch>  
*Frontiers in Ecol* (ESA, 2014) <http://onlinelibrary.wiley.com/doi/10.1890/1540-9295-12.10.540/full>  
*Ant Ecology* (Berliner Zeitung, 2014) <https://goo.gl/BP28A8>  
*Ants & Climate Change* (LiveScience, 2014) <https://goo.gl/o7M87o>  
*The Power of Poison* (AMNH, 2014) <https://www.amnh.org/exhibitions/the-power-of-poison/>  
*InnovationSpace* (ASU, 2013) [http://asunews.asu.edu/20130328\\_todd\\_innovationspace](http://asunews.asu.edu/20130328_todd_innovationspace)  
*Nasonia Research* (ASU, 2013) [http://asunews.asu.edu/20130213\\_wasppheromones](http://asunews.asu.edu/20130213_wasppheromones)  
*Biomimicry & Design* (ASU, 2012) <https://placesjournal.org/article/shaking-hands-with-a-sloth/>  
*Biomimicry* (ASU, 2011) <http://vimeo.com/30211881>

### Videography 2012 – Present

*The Strange Truth* (NatGeo, 2016) <http://channel.nationalgeographic.com/the-strange-truth/>  
*Why Does Ant Diversity Matter?* (Ant Course Video Series, 2015) <http://youtu.be/lgtZU5xraol>  
*Mark-Recapture Technique* (Ant Course Video Series, 2015) <http://youtu.be/ekSjRsnhJrk>  
*Tournament of the Ants* (New York Times, 2014) <http://nyti.ms/1mUfIzZ>  
*Student Spotlight* (ASU, 2014) <http://innovationspace.asu.edu/students/>  
*SIRG & friends* (ASU, 2013) <http://vimeo.com/86664707>  
*Flight of the Sexuials* (ASU, 2012) <http://vimeo.com/48173557>

### Biomimicry Consultant | Arizona State University Tempe, AZ

Served as biomimicry project consultant on the architectural redesign of ASU's Life Sciences A-wing building lobby and courtyard space 2013

### Associate Designer | Jones Apparel Group New York, NY

Designed denim and knit styles for the children's clothing line, *GLO jeans girls* 2004 - 2005

### Product Development Manager | Ecko Unlimited New York, NY

Oversaw design and development of knit styles for the women's fashion line, *Fetish* 2004

### Product Development Associate | Nesi Apparel Group New York, NY

Organized design and development for the women's fashion line, *RocaWear Juniors* 2002 - 2004

## **PUBLIC OUTREACH & EDUCATION**

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<b>Cal Day   University of California, Berkeley</b> Exhibit live insects and science demonstrations for university open house attendants <a href="http://calday.berkeley.edu/">http://calday.berkeley.edu/</a>	<b>Berkeley, CA</b> 2018 & 2019
<b>Bay Area Scientists in Schools (BASIS)   Community Resources for Science</b> Conduct hands-on, inquiry-based biology learning activities for 4 <sup>th</sup> and 5 <sup>th</sup> grade students in a weekly science education program <a href="https://www.crscience.org/volunteers/aboutbasis">https://www.crscience.org/volunteers/aboutbasis</a>	<b>East Bay, CA</b> 2017 – Present
<b>NightLife   California Academy of Sciences</b> Present videos and live biological assays to inform public attendees about ant behavior and ant diversity in the Bay Area <a href="http://www.calacademy.org/nightlife">http://www.calacademy.org/nightlife</a>	<b>San Francisco, CA</b> 2017 – Present
<b>Ask-a-Biologist   Arizona State University</b> Answer biology questions submitted online by K-12 students and connect Ask-a-Biologist resources with K-12 teachers <a href="http://askabiologist.asu.edu">http://askabiologist.asu.edu</a>	<b>Tempe, AZ</b> 2010 - Present
<b>Bay Area Science Festival   University of California, Berkeley</b> Created and implemented hands-on learning activities to teach attendees about the characteristics of ants and other insects, and how entomologists study them <a href="http://www.bayareascience.org/">http://www.bayareascience.org/</a>	<b>San Francisco, CA</b> 2016 & 2018
<b>BioBlitz   Save Mt. Diablo</b> Volunteered as an expert entomologist to survey and identify insects in the Mt. Diablo regional area <a href="http://www.savemountdiablo.org/">http://www.savemountdiablo.org/</a>	<b>Mt. Diablo, CA</b> 2017 & 2018
<b>Be A Scientist   Community Resources for Science</b> Mentored 7 <sup>th</sup> grade students in a 6-week, independent, science research project <a href="https://www.crscience.org/volunteers/BeAScientist">https://www.crscience.org/volunteers/BeAScientist</a>	<b>Berkeley, CA</b> 2018
<b>Night of the Open Door   Arizona State University</b> Exhibited live insects and ant colony displays for university open house attendants <a href="https://opendoor.asu.edu/tempe">https://opendoor.asu.edu/tempe</a>	<b>Tempe, AZ</b> 2016
<b>STEM Outreach   Flight 33</b> Developed and conducted science learning activities for K-12 students in a weekly after-school education and assistance program <a href="http://www.flight33.com">http://www.flight33.com</a>	<b>Guadalupe, AZ</b> 2015 - 2016
<b>Homecoming Block-Party   Arizona State University</b> Presented live insects and ant colony displays for university homecoming attendants <a href="https://homecoming.asu.edu/events/block-party">https://homecoming.asu.edu/events/block-party</a>	<b>Tempe, AZ</b> 2015
<b>Summer Flashlight Tours   Desert Botanical Garden</b> Volunteered as an expert entomologist to inform public attendees about insect diversity of the Sonoran Desert <a href="http://www.dbg.org">http://www.dbg.org</a>	<b>Phoenix, AZ</b> 2014

## **PUBLIC OUTREACH & EDUCATION (CONTINUED)**

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### **SOLS Takes a Hike | Arizona State University**

Led guided hikes at the Gilbert Riparian Preserve to teach local attendees about insects of the Sonoran Desert

<http://sols.asu.edu/hike>

**Tempe, AZ**  
2014

### **BEST Summer Program | Arizona State University**

Developed active learning exercises to teach camp attendees (grades 5-9) the process of using the scientific method while studying social insects

<http://engineering.asu.edu/summerprograms/best/index.html>

**Tempe, AZ**  
2013

### **InsectARium | Arizona State University**

Created 3D insect models for use in an online learning & research tool

<http://tblr.asu.edu/mtpd/insectarium/ar/flashcards3.php>

**Tempe, AZ**  
2013

### **CompuGirls | Arizona State University**

Served as a graphic design project consultant in a technology program for adolescent girls interested in computer sciences

<http://sst.clas.asu.edu/about/compugirls>

**Tempe, AZ**  
2010

### **Project Connect | Cincinnati Public Schools**

Volunteered as an after-school tutor for students (grades K-6)

<http://www.cps-k12.org/Academics/ProjConnect/ProjConnect.htm>

**Cincinnati, OH**  
2000