

# AJA M. CARTER, PH.D.

Postdoctoral Researcher  
Mechanical Engineering  
Carnegie Mellon University  
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## EDUCATION

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### University of Pennsylvania

Philadelphia, PA  
April 2020

*Ph.D in Earth and Environmental Sciences*

Dissertation: The Effects of Vertebral Morphology and Composition  
on Stem-Tetrapod Intervertebral Joint Functional Behavior

Fontaine Scholar: high achieving underrepresented doctoral students; Phillips Orville Fellow

### Drexel University

Philadelphia, PA  
June 2014

*B.S in Biology; Minor: Spanish*

*Senior Thesis: Geometric morphometric analysis of stem tetrapod forelimbs*

Mary K. Howett Memorial Scholar; Alliance for Minority Participation Scholar

## HONORS AND AWARDS

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<i>Vice Provost Postdoctoral Fellowship (\$197,000)</i>	2020-2023
<i>Outstanding Teaching Assistant Award</i>	2018
<i>Broadening Participation Award (\$500)</i>	2017
<i>Greg and Susan J. Walker Endowment (\$6,000)</i>	2017
<i>Paul Bond Scholarship (\$2500)</i>	2017
<i>Fontaine Fellowship (\$50,000)</i>	2014
<i>Philip Orville Fellowship (\$10,000)</i>	2014
<i>Mary K. Howett Memorial Scholarship in Biology (\$5,000)</i>	2013
<i>Anthony J. Drexel Scholarship (\$100,000)</i>	2010-2014

## RESEARCH EXPERIENCE

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Postdoctoral Research (Advisor: Aaron Johnson)

*Department of Mechanical Engineering, Carnegie Mellon University, 2023-Present*

- Became Trailblazer in Engineering Fellow (Purdue University July 2024)
- Mentored undergraduate and graduate students on various projects resulting in poster presentations
- Led projects on rapid prototyping small quadruped robots to conduct cost-benefit analysis of design changes
- Co-PI on NSF EDSE Grant
- Led survey on spined robots to elucidate design space and challenges in adding degrees of

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freedom to quadruped robots

- Described full workspace of ancient amphibian using Pybullet simulation
- Attended NSF Workshop on Mechanical Intelligence
- NSF Review Panelist

Postdoctoral Research (Advisor: Daniel Koditschek)

*Department of Electrical and Systems Engineering, General Robotics Automation Sensing and Perception lab, University of Pennsylvania, 2020-2023*

- Characterized dynamic capabilities of spinal columns from earliest land animals to aid in bio-inspired design of spines in legged robots
- Developed theoretical framework for using paleontology in bio-inspired robotic design
- Organized bi-weekly meetings for postdoctoral researchers, graduate students, and student researchers and across four universities for interdisciplinary works

Doctoral Research (Advisor: Peter Dodson)

*Department of Earth and Environmental Sciences, University of Pennsylvania, 2014-2020*

- Conducted kinematic studies on ancient vertebrae using AutoCad Inventor Fusion360
- Experimentally determined the Young's modulus of vertebrae in Permian (250 million years ago) using multi-material 3D printing
- Evaluated crushing resistance in ancient, shelled mollusks

Undergraduate Research (Advisor: Kenneth Lacovara)

*Department of Biology, Drexel University, 2010-2014*

- Assembled database of 100+ journal articles concerning geology and fossils found in New Jersey, anatomy of crocodylians and dinosaurs
- Described cranium of sub-adult ancient crocodile from New Jersey
- Properly identified two halves of an ancient crocodile skull mistakenly split between two departments of the Academy of Natural Sciences of Drexel University and developed a dichotomous key to aid in finding other disassociated materials

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## PUBLICATIONS

### Peer Reviewed Articles

**Carter, A.M.**, Chen, W-H., Misra, S., Sung, C.\* (2023) A Task-to-Intelligence Mapping: When is Embodied Intelligence Worth Designing? (*IOP Conference Series: Materials Science and Engineering*. Vol. 1292. No. 1)

Caporale, J. D., Feng, Z., Rozen-Levy, S., **Carter, A. M.**, & Koditschek, D. E. (2023). Twisting Spine or Rigid Torso: Exploring Quadrupedal Morphology via Trajectory Optimization. (IEEE International Conference on Robotics and Automation (ICRA) pp. 1177-1184)

Johnson, E., Peterman, D., & **Carter, A.M.** (2022). Updating studies of past life and ancient ecologies using defossilized organismal proxies. *Frontiers in Earth Science*, 2029

**Carter, A.M.**, and Roberts, S. (2022) The deep time perspective: How insights from millennia of evolving and extinct animals can inform robot design decision making. (*IOP Conference Series: Materials Science and Engineering*. Vol. 1261. No. 1)

Jasinski, S. E., Sullivan, R. M., **Carter, A. M.**, Johnson, E. H., Dalman, S. G., Zariwala, J., & Currie, P. J. (2022). Osteology and reassessment of *Dineobellator notohesperus*, a southern eudromaeosaur (Theropoda: Dromaeosauridae: Eudromaeosauria) from the latest Cretaceous of New Mexico. (*The Anatomical Record* 306.7 1712-1756).

**Carter, A.M.**, Johnson, E.H., Schroeter, E.A. (2022) Long-term Retention of diverse paleontologists requires increasing accessibility. (*Frontiers in Ecology and Evolution*: 595)

**Carter, A.M.**, Hsieh, S-T., Dodson, P., Sallan, L. (2021) Early amphibians evolved distinct vertebrae for habitat invasions. (*PLoS one* 16 (6), e0251983); DOI: 10.1371/journal.pone.0251983

Johnson, E.H., DiMarco, B., Peterman, D., **Carter, A.M.**, Allmon, W. (2021) Did Shell-Crushing Predators Drive the Evolution of Ammonoid Septal Shape? (*Paleobiology*, 1-14); DOI: 10.1017/pab.2021.13

Johnson, E.H., **Carter, A.M.** (2019) Defossilization: A Review of 3D Printing in Experimental Paleontology. (*Frontiers in Ecology and Evolution*,7,430.)

Lacovara K.J., Lamanna, M.C., Ibiricu, L.M., Poole, J.C., Schroeter, E.R., Ullmann, P.V., Voegelé, K.K., Boles, Z.M., **Carter, A.M.**, et.al., (2014) A gigantic exceptionally complete sauropod dinosaur from Southern Patagonia, Argentina (*Nature: Scientific Reports* 4, 6196); DOI: 10.1038/srep06196

### **In Preparation**

**Carter.A.M.**, Caporale, J.D., Koditschek, D.E., Johnson, A.M. Dynamic frequency analysis of predators and prey from the Red Bed deposits of Texas. *Royal Society Interface*

**Carter, A.M.**, Pardo, J., Johnson, A.M. Workspace analysis of a ‘Lepso-spondyl’ and walking ability of early tetrapods. *Nature Ecology and Evolution*

**Carter, A.M.**, Kroman, S., Ramirez, E., Johnson, A.M. Where are our spined robots? Cost-benefit analysis of spined robots. *Science Robotics*

**Carter, A.M.**, Molina, D., Ramirez, E., Johnson, A.M., Cost benefit analysis of twisting spine designs in quadrupeds. *IROS 2025*

### **Abstracts**

**Carter, A.M** and Johnson, A.M. “Dynamic gaits in extinct taxa and bio-inspired robots,” in *Dynamic Walking*, 2024

Johnson, A.M., **Carter, A.M.**, Nimako-Boateng, S., Kroman, S., et al. “Where are our robot spines?” In Dynamic Walking, 2024

**Carter, A.M.**, Caporale, J.D., Musser, E., Koditschek, D. Investigating Spinal Column Dynamics in Crown Terrestrial Amniotes. (Society for Integrated and Comparative Biology Annual Meeting, Phoenix Austin 2023)

**Carter, A.M.**, Johnson, E.H., Bissette, R., Hsieh, S.T., Dodson, P. Multimaterial 3D printing to explore vertebral stiffness in stem Tetrapods. (Society for Integrated and Comparative Biology Annual Meeting, Phoenix Arizona 2022)

Johnson, **Carter, A.M.**, Schroeter, E.R. Increasing accessibility to increase diversity in paleontology. (Society for Integrated and Comparative Biology Annual Meeting, Phoenix Arizona 2022)

Johnson, E., **Carter A.M.**, Schroeter, E.A. Increasing Diversity in Paleontology Requires Increasing Accessibility. 2021 Geological Society of America *Abstracts with Programs*. Vol 53, No. 6 doi: 10.1130/abs/2021AM-370949

Johnson, E.H. and **Carter A.M.**, “3D Printing for Biomechanical Studies of Shell Shape and Strength”. (European Association of Vertebrate Paleontologists, July 2020)

**Carter, A.M.**, Hsieh, S.T., Dodson, P. Method development in biomimetic models using 3D printed materials (Geological Society of America Annual Meeting, Indianapolis, IN, 2018)

DiMarco, B., Johnson E.H., **Carter, A.M.**, Sime, J., Sallan, L. Exploring the function of suture complexity with experimental compression of 3D printed ammonoids. (Geological Society of America Annual Meeting, Indianapolis, IN, 2018)

Sajdah-Bey, N., **Carter, A.M.**, Johnson, E.H., Sallan, L. 3D Printing pectoral fins attached to back of the skull in extinct cartilaginous fishes (Iniopterygians) to understand function. (Geological Society of America Annual Meeting, Indianapolis, IN, 2018)

**Carter,A.M.**, Hsieh, S.T., Dodson, P., Sallan,L. Ecomorphology in Temnospondyli (Amphibia) vertebrae: a geometric morphometrics study (Society for Integrated and Comparative Biology Annual Meeting Programs and Abstracts Book, San Francisco, CA)

**Carter, A.M.**, Hsieh, S.T., Dodson, P., Sallan, L. Ecomorphological implications of presacral morphology in temnospondyli (Evolution 2017, Portland, OR)

**Carter, A.M.**,Sallan, L., Hsieh S-T., Dodson, P. 2016 Just How Different? Quantifying Vertebral Diversity in Temnospondyls (Journal of Vertebrate Paleontology SVP Programs and Abstracts Book, 2016, p. 76, Dallas, TX)

**Carter, A.M.**, K.J. Lacovara, 2011. Bringing Old Collections into New Focus. (Minority Access Inc Research Symposium, Washington, D.C. 2012)

### **Posters**

DiMarco, B., Johnson, E.H., **Carter, A.M.**, Allmon, W.D. The Evolution of Ammonoid Septa Complexity: A Product of Predation? GSA Annual Meeting in Phoenix, Arizona, USA-2019

**Carter, A.M.**, Standen, E., Sallan, L., Dodson, P., Hsieh, S-T. Obstacle crossing behaviors in the Senegalese bichir, *Polypterus senegalus* (Society for Integrated and Comparative Biology Annual Meeting Programs and Abstracts Book 2017, New Orleans, LA)

**Carter, A.M.**, Sallan, L., Hsieh S-T., Dodson, P. 2016 Quantifying Vertebral Diversity in Temnospondyls (Society for Integrated and Comparative Biology Annual Meeting Programs and Abstracts Book 2016, Portland, OR)

**Carter, A.M.**, Boles, Z.M., Schroeter, E.R, and Lacovara, K.J. 2012. A juvenile *Hyposaurus rogersii* skull from the Hornerstown Formation of New Jersey. (Fifteenth Annual Philadelphia Alliance for Minority Participation Research Symposium and Mentoring Conference, 2013, Philadelphia, PA.)

**Carter, A.M.**, Lacovara, K.J. Bringing Old Collections into New Focus. (Fourteenth Annual Philadelphia Alliance for Minority Participation Research Symposium and Mentoring Conference, 2011 Philadelphia PA)

## INVITED LECTURES

**Carter, A.M.**, “TBD”, Establishing Disciplinary Norms for Research Methods in Robotics, ICRA 2025

**Carter, A.M.**, “Motion from Stone: The Dawn of Paleobionics” Dippy 125<sup>th</sup> Celebration, Carnegie Museum of Natural History, July 12<sup>th</sup>, 2024

**Carter, A.M.** “PaleoPerformance: Connections between Paleobiology and Bioinspired Robots” Princeton University Robotics Seminar, April 12<sup>th</sup>, 2024

**Carter, A.M.** “A Paleobiological Search for Dynamic Gaits in our Paleozoic Ancestors Modeling” Georgia Tech Biology Department Seminar, September 28<sup>th</sup>, 2023

**Carter, A.M.** “250-Million-Year-Old Connections” Georgia Tech Emerging Scholars Lecture Series. April 11<sup>th</sup>, 2023 (*Invited*)

**Carter, A.M.**, Johnson, E.J., Bisette, R., Hsieh, S-T., Dodson, P. “Range of Motion in Vertebrae of Stem Tetrapods.” European Association of Vertebrate Paleontologists. Virtual Meeting. July 6<sup>th</sup>, 2021 (*Invited*)

**Carter, A.M.**, “Making Monsters Move: Osteological Range of Motion Studies.” University of Birmingham. May 27<sup>th</sup>, 2020 (*Invited*)

**Carter, A.M.**, “How many cheeseburgers could T-Rex Eat? Silly Questions that Inspire Science” Philadelphia Area Girls Enjoying Science. September 27<sup>th</sup>, 2014 (*Keynote Speaker*)

## TEACHING EXPERIENCE

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**Department of Earth and Environmental Sciences, University of Pennsylvania** 2016,2018

*Teaching Assistant:*

- *Earth and Life Through Time (ENVS 210)*
  - *Awarded: Outstanding Teaching Assistant Award*
- *Introduction to Environmental Earth (ENVS 100)*

**Department of Geology, Rowan University** 10/2019

*Guest Lecturer:*

- *Vertebrate Paleontology (GEO 311)*

**Department of Biology, North Carolina State University** 09/2022,11/2022-10/2024

*Guest Lecturer:*

- *The Science of Studying Dinosaurs (BIO 230)*
- *Evolution (BIO 270)*

## OUTREACH AND SCIENCE COMMUNICATION

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### Museum Education

Museum Education Staff, Academy of Natural Sciences, Philadelphia PA 2011-2014

Inaugural Scientist Speaker, Academy of Natural Sciences, Philadelphia PA 12/2017

### K-12 Outreach

**Carter, A.C.**, “Robots, Dinosaurs and You! Paleobionics,” Governor’s School, North Carolina, July 14<sup>th</sup> 2024

**Carter, A.C.**, “My Journey Through My Questions,” National Honors Society Inductees, Germantown Academy, June 5<sup>th</sup>, 2024

**Carter, A.C.**, “Paleontology, Robotics, and finding ‘Good Ideas’”, Upward Bound Rule Your Future STEAM Initiative, October 7<sup>th</sup>, 2022

**Carter, A.C.**, “How to become a Paleontologist”, Girl Scout Silver Award, Troop # 6260, Sandy Springs, GA. June 19<sup>th</sup>, 2021

**Carter, A.C.**, “Where can we find a giant dinosaur?” Germantown Academy, Fort Washington PA, February annually 2015-2019 (2<sup>nd</sup> grd)

### Stem Outreach for the Public

“Paleobionics: Dinosaurs Are Back” CMU Podcast Where What If Becomes What’s Next, September 11<sup>th</sup>, 2024

“Pittsburgh’s dino diaspora draws paleontologists from around the world, spurs new tech research”, Pittsburgh Post-Gazette, July 29<sup>th</sup>, 2024

“Defossilization: A Review of 3D Printing in Experimental Paleontology” Delaware Valley Paleontological Society, Academy of Natural Sciences, Philadelphia, PA. June 9<sup>th</sup>, 2020

“Put your back into it!” Science on Tap, Philadelphia PA, May 20<sup>th</sup>, 2019

“A field guide to Vertebral Diversity” Delaware Valley Paleontological Society, Academy of Natural Sciences, Philadelphia, PA. May 21<sup>st</sup>, 2019

### **Outreach via Video**

*Digital Series Talent*, “Drain the Jurassic” (Host: National Geographic), July 18-20<sup>th</sup>, 2022

*Digital Series Talent*, “Dinosaurs of Antarctica” (Host: Giant Screen Studios LLC), July 16, 2022

*Guest Speaker*, “Robot Dinosaurs?” (Host: Franklin Outside, Franklin Institute – Science Museum, Philadelphia PA) March 17, 2021

*Guest Speaker*, “Scientist Spotlight” (Host: State Impact – NPR, Pennsylvania) September 22, 2020

### **Mentorship**

Brianna DiMarco (second author publication, first author poster presentation), Drexel University

Kim Hansen (first author poster presentation), CMU

## **FIELD EXPERIENCE**

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**New Jersey** (*Drexel University, the New Jersey State Museum*) 2009-2014

Hornerstown Formation, Sewell County, New Jersey (Cretaceous Marine)

**Montana** (Museum of the Rockies) 2009

Hell Creek Formation, Jordan, Montana (Cretaceous Vertebrates)

## **DEPARTMENTAL SERVICE ACTIVITIES**

### **Panels**

*Panelist and Activity Designer*—Visiting Students to the GRASP Lab 08/2023

Local Highschools, GRASP Outreach, Philadelphia, PA

Local Highschools, GRASP Outreach, Philadelphia, PA

*Panelist and Activity Designer*—STEM GOES RED 02/2023

Red Cross, GRASP Outreach, Philadelphia, PA

*Panelist*, Candid Conversations - Standards of Professionalism: Breaking 02/2022

the Mold, Students Tackling Advanced Research (STARs) of Drexel

University

*Panelist*, Black History in STEM Fields, Alliance for Minority 09/2021

Participation of Drexel University

*Panelist*, Men of Honor and Women of Distinguish, STEM Journey,  
Alliance for Minority Participation of Drexel University

10/2017

### **Department Seminars**

**Carter, A.M.**, Ullman, P., and Lacovara, K.J. 2014. Morphometric Study of the Pectoral Girdle in Early Tetrapods. Senior Research Day. (Drexel University, Philadelphia, PA 2014)

### **Department Poster Presentations**

**Carter, A.M.**, Fowler, E., Schiff, N., and Lacovara, K.J. 2013. Restoration of a Cretaceous Crocodile through Digital and Traditional Paleontology Techniques. (University Research Day 2013, Drexel University, Philadelphia PA.)

**Carter, A.M.**, Boles, Z.M., Schroeter, E.R., and Lacovara, K.J. 2012 A juvenile *Hyposaurus rogersii* skull from the Hornerstown Formation of New Jersey. (College of Arts and Sciences Research Day 2012, Drexel University, Philadelphia PA)

**Carter, A.M.**, Boles, Z.M., Schroeter, E.R., and Lacovara, K.J. 2012, A juvenile *Hyposaurus rogersii* skull from the Hornerstown Formation of New Jersey. (University Research Day 2012, Drexel University, 2012 Philadelphia, PA)

**Carter, A.**, Lacovara, K.J. Bringing Old Collections into New Focus. (STAR Scholars Symposium, Drexel University, 2011, Philadelphia PA)

### **Laboratory**

Fossil Preparator, Academy of Natural Sciences

2009-2014

### **Professional Societies Memberships**

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Institute of Electrical and Electronics Engineers (IEEE)

Explorer's Club

Sigma XI

Society for Integrative and Comparative Biology (SICB)

Society of Vertebrate Paleontology (SVP)

Geological Society of America (GSA)

Fontaine Society University of Pennsylvania

DuBois Postdoctoral Association

### **Peer Reviewer**

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Journal of Anatomy

Public Library of Science (PLOS)

Paleobiology

### **Grants**

Paleobiology Summer Stipend

2019

Paleobiology Summer Stipend

2017



Graduate Student and Professional Student Association Travel Grant	2017
Second Place in Biology, 15 <sup>th</sup> Annual Alliance for Minority Participation Research Symposium	2012
Joan Summerfield Award for Excellence in Teaching (Nomination)	2012
Third Place in Biology, 14 <sup>th</sup> Annual Alliance for Minority Participation Research Symposium	2011
Joan Summerfield Award for Excellence in Teaching (Nomination)	2011