



**SUMMARY REPORT 2023**







**CENTER FOR ACADEMIC RESEARCH  
AND TRAINING IN ANTHROPOGENY**

UNIVERSITY OF CALIFORNIA SAN DIEGO & SALK INSTITUTE FOR BIOLOGICAL STUDIES

## CARTA

The Center for Academic Research and Training in Anthropogeny (CARTA) is a virtual organization formed to promote transdisciplinary research on human origins by drawing on methods from a number of traditional disciplines spanning the social, biomedical, biological, computational and engineering, physical and chemical sciences, and the humanities. CARTA is a collaboration between faculty at UC San Diego and at the Salk Institute for Biological Studies, along with interested scientists at other institutions.

Center for Academic Research  
and Training in Anthropogeny (CARTA)  
University of California San Diego  
9500 Gilman Drive # 0060  
La Jolla, CA 92093-0060  
Phone: 858-246-0846

-  [carta.anthropogeny.org](https://carta.anthropogeny.org)
-  [carta-info@anthropogeny.org](mailto:carta-info@anthropogeny.org)
-  [cartaucsd](#)
-  [ucsdcarta](#)
-  [ucsdcarta](#)
-  [cartaucsd](#)

**Creative Lead**  
Jesse Robie

**Contributors**  
Pascal Gagneux  
Lindsay Hunter  
Kate Kaya  
Linda Nelson  
Ben Tolo

**CARTA Summary Report 2023**  
(Scan the QR code for online PDF)



© 2023 The Center for Academic Research and  
Training in Anthropogeny

## CARTA Overview

- 2** Co-Directors' Message
- 3** What is CARTA?
- 3** What is Anthropogeny?
- 4** Organization
- 6** The Origins of CARTA
- 8** By the Numbers
- 9** Partners
- 9** Active Funders
- 9** Past Funders

## Symposia

- 10** Public Symposia
- 11** Discussion Sessions
- 12** Total Online Viewership
- 13** Livestream Viewership
- 13** Symposium Sponsorships
- 14** Posters
- 14** Glossary
- 15** Impact of COVID

## Members

- 16** CARTA Members
- 17** Local Member List
- 18** Member Expertise
- 19** Scales of Investigation
- 19** Member Locations
- 20** Selected Member Comments
- 22** Member Collaborations
- 26** CARTA-Inspired Publications

## Education

- 28** The Graduate Specialization in Anthropogeny
- 29** Program Requirements
- 29** Goal of the Specialization
- 29** The Broad Topic Areas
- 30** Program Statistics
- 30** Fellowships
- 31** Current Students
- 32** Anthropogeny Field Course
- 33** Partnership with GMERC
- 34** Selected Student Comments
- 36** Student Involvement in Symposia
- 37** Where are They Now?

## Resources

- 38** MOCA
- 38** COMP/ANTH
- 40** MOP
- 40** PFA Collection
- 40** Gavan Collection
- 41** Curation Project

## Outreach

- 42** Public Engagement
- 44** Informal Learning
- 45** CARTA Rap Videos
- 46** General Public Comments

## Future Outlook

- 48** The Value of CARTA
- 49** Insights and Questions
- 49** Future Efforts



## CO-DIRECTORS' MESSAGE EXPLORING THE ORIGINS OF THE HUMAN PHENOMENON

Dear Friends,

This report outlines the many contributions of CARTA with regard to catalyzing collaborative work, educational opportunities for UC San Diego students, and public education. Here, we share feedback from CARTA members, Graduate Specialization in Anthropogeny students and alumni, and the broader public, both nationally and internationally.

Anthropogeny, the study of human origins, is motivated by one of the big unanswered questions of humanity: “Where did we come from?” The Center for Academic Research and Training in Anthropogeny (CARTA), a collaboration between UC San Diego and the Salk Institute for Biological Studies, continues to pursue its stated goal of “exploring and explaining the origins of the human phenomenon.” This is accomplished in four principal ways: 1) Symposia that promote transdisciplinary dialogue among experts from around the world to address important topics and recent developments in human origins research; 2) Training the next generation of scientists, students, and thinkers in the ability to integrate different knowledge bases; 3) Engaging the public in CARTA’s ongoing exploration by sharing symposia presentations synchronously and archiving closed-captioned videos through YouTube, UCTV/UCSD-TV, and other sites; and 4) Providing free and open-access anthropogeny-related resources to the public via our website.

A better understanding of human behavior and the unique combination of biocultural processes that have shaped our

species is crucial, especially when addressing the important and urgent challenges we face today. Anthropogenic climate change is an immediate threat and the human-caused global biodiversity crisis amounts to the sixth mass extinction event in the Earth’s history. Other issues range from medicine to child-rearing, from education to mediating social conflicts, and from neuroscience to artificial intelligence.

CARTA was founded 15 years ago by a small group of faculty from UC San Diego and the Salk Institute for Biological Studies. It has since grown into a global virtual organization with over 400 expert members, representing diverse scientific disciplines across both the natural and social sciences, including the arts and humanities. Members are faculty engaged in research relevant to the understanding of human origins. CARTA has organized and administered 46 public symposia, each of them followed by a day-long discussion session for the speakers, CARTA members, and graduate student participants in the UC San Diego Graduate Specialization in Anthropogeny. CARTA public symposium talks are livestreamed, recorded, and made freely available online through partnership with University of California Television (UCTV), as well as on the CARTA website, which has over 12,000 registered users. These online CARTA recordings, many with professional closed captioning, have generated more than 42 million views to date, making CARTA UCTV’s most popular “Science” series and their second most popular series overall.

Thanks to the livestream infrastructure established in 2012 (groundbreaking at that time), and the high-quality video production process, CARTA was well positioned to transition to online-only events at the start of the COVID-19 pandemic in early 2020. Through partnership with local infectious disease experts, faculty from UC San Diego Health, the Salk Institute for Biological Studies, and the La Jolla Institute for Immunology (LJI), CARTA was able to quickly change a planned in-person event to completely virtual for May 2020 (*The Impact of Infectious Disease on Humans and Our Origins*).

Many CARTA members have engaged in numerous collaborations directly facilitated by its meetings. Over 50 local faculty from UC San Diego, including Health Sciences, Scripps Institution of Oceanography (SIO), and the Salk Institute for Biological Studies, are CARTA members and provide a diverse range of invaluable expertise. Many of these local members

have regularly lectured for the Osher Lifelong Learning Institute’s Master Classes in Anthropogeny.

We are delighted to share that on November 3, 2023, two of our Graduate Specialization in Anthropogeny alumni returned as invited speakers for our 46th symposium (*Comparative Anthropogeny and Other Approaches to Human Origins*) and have since been invited to become CARTA members.

CARTA looks forward to furthering our transdisciplinary exploration of our common origins and shared humanity. CARTA is proud to contribute to UC San Diego’s profile through global recognition in the study of human origins.

Happy reading and best wishes.

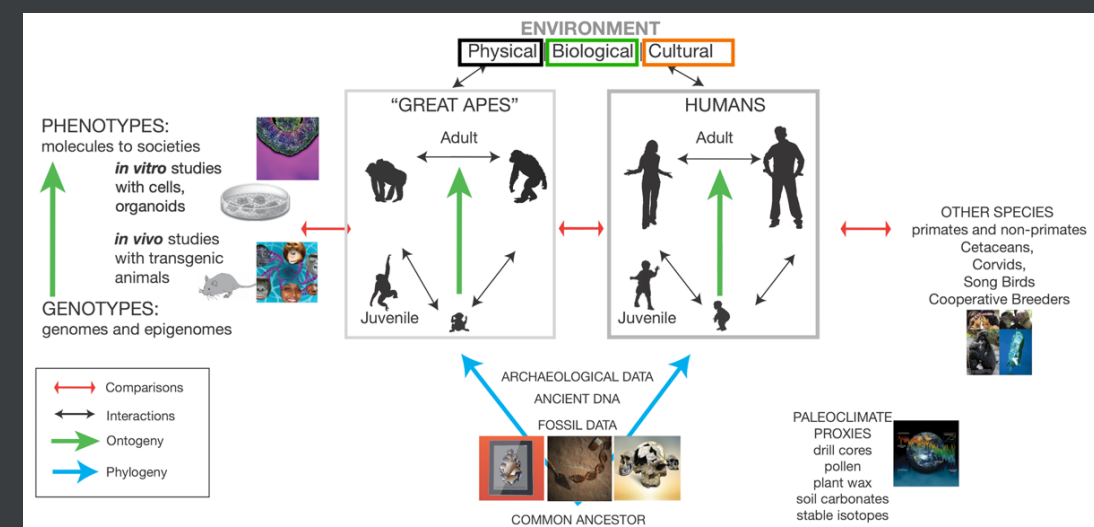
**Pascal Gagneux**, CARTA Executive Co- Director  
**Katerina Semendeferi**, CARTA Co-Director  
**Gerald F. Joyce**, CARTA Co-Director

## WHAT IS CARTA?

The Center for Academic Research and Training in Anthropogeny (CARTA) is a collaboration between UC San Diego and the Salk Institute for Biological Studies faculty, along with a global panel of prominent experts, to promote transdisciplinary research on human origins. Our core programs include symposia to share and stimulate research on what makes us human, and the Graduate Specialization in Anthropogeny available to PhD students in participating departments at UC San Diego.

## WHAT IS ANTHROPOGENY?

Anthropogeny is the scientific investigation of the origins of our species. Anthropogeny utilizes fossil, archaeological, and genomic evidence. It includes the comparison of genomes, development, life histories, and behavior across humans and our closest living relatives (and other species). Anthropogeny explores the impact of genetic changes in model systems and studies the roles of biological and cultural environments.



Modified from: Varki, A. & Nelson, D.L. (2007). Genomic Comparisons of Humans and Chimpanzees. *Annual Review of Anthropology*, 36.

## Organization

### CO-DIRECTORS



**Pascal Gagneux**  
Executive Co-Director, CARTA;  
Professor, Departments of Pathology and  
Anthropology, UC San Diego



**Katerina Semendeferi**  
Co-Director, CARTA; Director, Laboratory  
for Human Comparative Neuroanatomy;  
Co-Director, Archealization Center;  
Professor, Department of Anthropology,  
UC San Diego



**Gerald F. Joyce**  
Co-Director, CARTA; President and  
Professor, Salk Institute for  
Biological Studies

### ASSOCIATE DIRECTORS



**Rachel Mayberry**  
Associate Director, CARTA;  
Director, Laboratory for  
Multi-Modal Language  
Development; Professor,  
Department of Linguistics,  
UC San Diego



**Alysson Muotri**  
Associate Director, CARTA;  
Co-Director, Archealization  
Center; Professor, Departments  
of Pediatrics and Cellular and  
Molecular Medicine,  
UC San Diego



**Robert Kluender**  
Professor, Department of  
Linguistics, UC San Diego



**Carol Marchetto**  
Professor, Department of  
Anthropology, UC San Diego;  
Adjunct Assistant Professor, Salk  
Institute for Biological Studies

### ADMINISTRATION



**Linda Nelson**  
Management Services  
Officer



**Lindsay Hunter**  
Community Engagement  
and Advancement Director



**Jesse Robie**  
Program Coordinator



**Kate Kaya**  
CyberInfrastructure  
Lead



**Viswanath Nandigam**  
CyberInfrastructure  
Specialist

### EXTERNAL ADVISORS



**Alyssa Crittenden**  
Dean of the Graduate College;  
Professor, Department of Anthropology,  
University of Nevada, Las Vegas



**Evan Eichler**  
Investigator, Howard Hughes Medical  
Institute; Professor, Department of Genome  
Sciences, University of Washington



**Daniel Geschwind**  
Distinguished Professor of Human  
Genetics, Neurology, and Psychiatry,  
School of Medicine, UCLA



**Yohannes Haile-Selassie**  
Director, Institute of Human Origins;  
Virginia M. Ullman Professor of Natural  
History and the Environment,  
Arizona State University



**Joseph Henrich**  
Ruth Moore Professor of Biological  
Anthropology, Department of Human  
Evolutionary Biology, Harvard University



**Terrence Sejnowski**  
Francis Crick Chair, Professor,  
Computational Neurobiology Laboratory,  
Salk Institute for Biological Studies



**Anne Stone**  
Regents Professor and Associate Director,  
Center for Evolution and Medicine, School  
of Human Evolution and Social Change,  
Arizona State University



**Sarah Tishkoff**  
Director, Penn Center for Global Genomics  
and Health Equity; David and Lyn Silfen  
University Professor in Genetics and  
Biology, University of Pennsylvania

### EMERITI CO-DIRECTORS



**Ajit Varki**  
Founding Executive Co-Director, CARTA;  
Distinguished Professor of Medicine and  
Cellular & Molecular Medicine, UC San  
Diego; Adjunct Professor, Salk Institute  
for Biological Studies



**Fred Gage**  
Founding Co-Director, CARTA; Professor  
and former President, Salk Institute for  
Biological Studies; Adjunct Professor of  
Neurosciences, UC San Diego



**Margaret Schoeninger**  
Founding Co-Director, CARTA;  
Distinguished Professor Emerita of  
Anthropology, UC San Diego

## The Origins of CARTA

Researchers in diverse fields related to human origins (anthropogeny) began meeting in the La Jolla area in the late 1990s, an effort coordinated by the UC San Diego Project for Explaining the Origin of Humans (POH). The group consisted of experts in San Diego and many others from around the world. The primary activity of the group was to organize transdisciplinary meetings in La Jolla, and to facilitate interactions via the internet.

As wider interest grew and practical opportunities surfaced, the original Project was re-established in January 2008 as a formal Organized Research Unit (ORU)

at UC San Diego and in close collaboration with interested faculty at the Salk Institute for Biological Studies. Thus, the Center for Academic Research and Training in Anthropogeny, or CARTA, was founded.

CARTA is now a center with over 400 members that facilitates transdisciplinary dialogue among researchers in combination with graduate education in relevant departments and programs to equip the next generation of scholars who will formulate and address questions concerning the origins of humanity.

**1990 | 1995**

Informal meetings, organized by Ajit Varki, bring together local researchers to inquire about human uniqueness from the perspective of their specialties:

- Kurt Benirschke (comparative pathology)
- Roy D'Andrade (anthropology)
- James J. Moore (biological anthropology)
- Floyd Bloom (neurosciences)
- Russell Doolittle (biology)
- David Perlmutter (linguistics)
- Theodore Bullock (neurosciences)
- Fred H. Gage (neurosciences)
- Terry Sejnowski (neurosciences)
- Patricia Churchland (philosophy)
- Bob Katzman (neurology)
- Ajit Varki (medicine; cellular and molecular medicine)

**1996 | 1997**

January 1996: First formal organization of these meetings under the name, The La Jolla Group for Explaining the Origin of Humans (LOH).

**1998 | 2000**

February 1998: First formal LOH meeting, *Explaining Humans*, takes place with support from the Preuss Family Foundation.

The G. Harold and Leila Y. Mathers Foundation begins support for LOH.

**2001 | 2003**

LOH becomes the UC San Diego-recognized Project for Explaining the Origins of Humans (POH).  
The POH website launches with help from Chaitan Baru, San Diego Supercomputer Center.  
POH launches the first iteration of the online resource, the Matrix of Comparative Anthropogeny (MOCA), with help from Viswanath Nandigam, San Diego Supercomputer Center.

**2004 | 2007**

March 2004: First POH public symposium, *Sequencing the Chimpanzee Genome: What Have We Learned?*  
The Primate Foundation of Arizona (PFA) donates a collection of chimpanzee skeletons, other samples, and records to POH. The Museum of Primatology (MOP) at UC San Diego is created to organize the collections.

**2008 | 2009**

January 2008: POH becomes the Center for Academic Research and Training in Anthropogeny (CARTA) with founding co-directors Ajit Varki, Fred Gage, and Margaret Schoeninger.  
September 2008: First CARTA public symposium, *Anthropogeny: Defining the Agenda*.  
Annette C. Merle-Smith begins support of CARTA public symposia.

**2010 | 2012**

March 2010: CARTA establishes the Graduate Specialization in Anthropogeny (a parenthetical degree program for students from participating graduate departments) and the CARTA fellowship in Anthropogeny at UC San Diego.  
Digitization of the PFA chimpanzee skeletons as a virtual resource for research and comparative primatology with funding provided by Annette C. Merle-Smith.

**2013 | 2019**

May 2015: CARTA establishes the Annette C. Merle-Smith Fellowship established to support Graduate Specialization in Anthropogeny students.  
October 2016: CARTA partners with Arizona State University to co-sponsor the symposium, *Implications of Anthropogeny for Medicine and Health*.  
May 2017: CARTA partners with the KAVLI Institute for Brain and Mind to co-sponsor the symposium, *Extraordinary Variations of the Human Mind: Lessons for Anthropogeny*.  
June 2018: The Paul G. Allen Frontiers Group co-supports the symposium, *Imagination and Human Origins*.  
October 2018: CARTA partners with the KAVLI Institute for Brain and Mind to co-sponsor the symposium, *Impact of Tool Use and Technology on the Evolution of the Human Mind*.  
New external advisory board named: Alyssa Crittenden (University of Nevada Las Vegas), Evan Eichler (University of Washington), Daniel Geschwind (University of California Los Angeles), Joseph Henrich (Harvard University), Anne Stone (Arizona State University), and Sarah Tishkoff (University of Pennsylvania).  
October 2019: Nissi and Ajit Varki contribute a major gift in support of the continuance of CARTA's mission.

**2020 | 2023**

May 2020: CARTA converts its public symposia to virtual events in response to the coronavirus disease (COVID-19) pandemic, starting with *Impact of Infectious Diseases on Humans and Our Origins*.  
March 2021: Graduate Specialization in Anthropogeny alumnus, Benjamin Cipollini PhD '14, sponsors the virtual symposium, *Altered States of the Human Mind*.  
May 2021: Annette C. Merle-Smith initiates support for MOCA/CompAnth project. The National Center for Biotechnology Information (NCBI) of the National Library of Medicine (NLM) agrees to publish completed MOCA entries as a free online book named *CompAnth*.  
November 2021: CARTA surpasses 40-million video views of its long-running symposium series. This remarkable milestone was achieved thanks to partnerships with UC San Diego, Salk Institute for Biological Studies, San Diego Supercomputer Center, and UCSDTV/UCTV.  
July 2022: Transition to current CARTA leadership.  
September 2022: Yohannes Haile-Selassie, Director of the Institute of Human Origins at Arizona State University, joins CARTA's external advisory board.  
May 2023: CARTA resumes in-person symposia with *The Role of Myth in Anthropogeny*.  
August 2023: CARTA co-sponsors Arizona State University's Institute of Human Origins (IHO) symposium, *Lucy 50th Anniversary Symposium: The Impact of "Lucy" on Human Origins* (April 2024).

Scan the QR code to read about the late Jim Handelman's impact on CARTA.

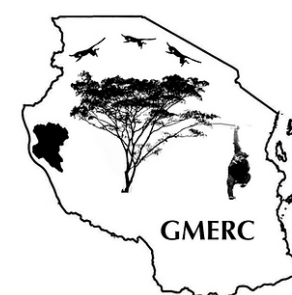


## By the Numbers

ORGANIZATION	EDUCATION
<b>400</b> CARTA MEMBERS	<b>\$2.3M</b> FELLOWSHIP FUNDING TO UC SAN DIEGO GRADUATE STUDENTS
<b>&gt;1K</b> CARTA-INSPIRED PUBLICATIONS PUBLISHED BY CARTA MEMBERS	<b>&gt;100</b> FELLOWSHIPS AWARDED
<b>&gt;12K</b> REGISTERED CARTA WEBSITE USERS	<b>48</b> FELLOWSHIP RECIPIENTS
<b>46</b> SYMPOSIA	<b>20</b> CURRENT STUDENTS (Students enrolled in the Graduate Specialization in Anthropogeny)
<b>414</b> SYMPOSIA VIDEOS	<b>42</b> GRADUATED STUDENTS
<b>&gt;42M</b> SYMPOSIA VIEWS	<b>42</b> AFFILIATE STUDENTS (Other students who enrolled in Anthropogeny courses)
<b>22</b> COUNTRIES WITH CARTA MEMBERS	<b>10</b> ANTHROPOGENY FIELD COURSES
<b>27</b> NEWSLETTERS	<b>46</b> ANTHROPOGENY FIELD COURSE STUDENT PARTICIPANTS
<b>&gt;7K</b> NEWSLETTER SUBSCRIBERS	
<b>2.9K</b> X/TWITTER FOLLOWERS	
<b>2.2K</b> FACEBOOK FOLLOWERS	

## Partners

UC San Diego UC San Diego Health



### Active Funders

#### Major Sponsor (\$500,000+)

- Anonymous
- Nissi & Ajit Varki

#### Patron (\$10,000+)

- Ingrid M. Benirschke-Perkins '79 & Gordon C. Perkins '82
- Benjamin N. Cipollini PhD '14
- William H. Calvin & Katherine Graubard Calvin
- Donald & Natalie Handelman
- Sarah B. & Daniel B. Hrdy
- Elizabeth C. Lancaster & Eli Shefter

\* Deceased

### Past Funders

#### Founding Sponsor (\$10 million+)

- The G. Harold & Leila Y. Mathers Charitable Foundation (James H. Handelman\*, Executive Director)

#### Major Sponsor (\$500,000+)

- Annette C. Merle-Smith\*

#### Benefactor (\$25,000+)

- Rita L.\* & Richard C. Atkinson
- The Kavli Institute for Brain and Mind

#### Patron (\$10,000+)

- The Paul G. Allen Frontiers Group
- Francisco J. Ayala\*
- Kurt Benirschke\*
- The Preuss Foundation for Medical Research
- Primate Foundation of Arizona



## Discussion Sessions

Following the public symposium, CARTA organizes a discussion session on the same topic that is restricted to CARTA members, Graduate Specialization in Anthropogeny students, guest observers, and invited science writers. The primary purpose of these sessions is to discuss explanations for the origins and workings of the human phenomenon and to generate new ideas and agendas for exploring the matter. CARTA discussion sessions are held in-person in the Trustees' Room at the Salk Institute and virtually over Zoom. 30-minute discussion periods for each speaker/topic are followed by an overall discussion and question and answer session. This format promotes interactions between graduate students and speakers to provide students with the opportunity to network with and learn from researchers outside of their respective fields. The sessions are video recorded by Salk Media Services and archived on the CARTA website.

DISCUSSION SESSIONS  
ARE MORE INTIMATE  
AND CONDUCTIVE  
TO EVALUATING  
AND EXCHANGING

# IDEAS

TO SPARK NEW  
COLLABORATIONS

OVER THE LAST  
15 YEARS

# CARTA

HAS ORGANIZED

# 46

PUBLIC SYMPOSIA  
AND AMASSED  
OVER

# 42

MILLION VIDEO VIEWS

## Public Symposia

CARTA organizes free public symposia that address aspects of human origins and uniqueness. These symposia feature presentations by researchers, eminent in their respective fields, specifically directed towards researchers in other fields and an educated lay audience, while highlighting clear and simple messages. Audience participation, both in person and online, is encouraged through a live question and answer session at the end of each event. Public symposia are held three times during the academic year, either in-person with livestream or entirely virtual. In-person events are held at the Salk Institute for Biological Studies in La Jolla, California. Audiences generally range from 500-700 participants and include UC San Diego and Salk Institute faculty, postdoctoral scholars, graduate and undergraduate students from multiple disciplines, UC San Diego alumni and emeriti faculty, and interested members of the public. All CARTA symposia are recorded by UCSD-TV for broadcast across the UCTV channel and archived on the CARTA, UCSD-TV, iTunes, and YouTube websites.



CARTA discussion sessions foster collaborative interactions.

# 42 Million Views of CARTA's symposia videos!

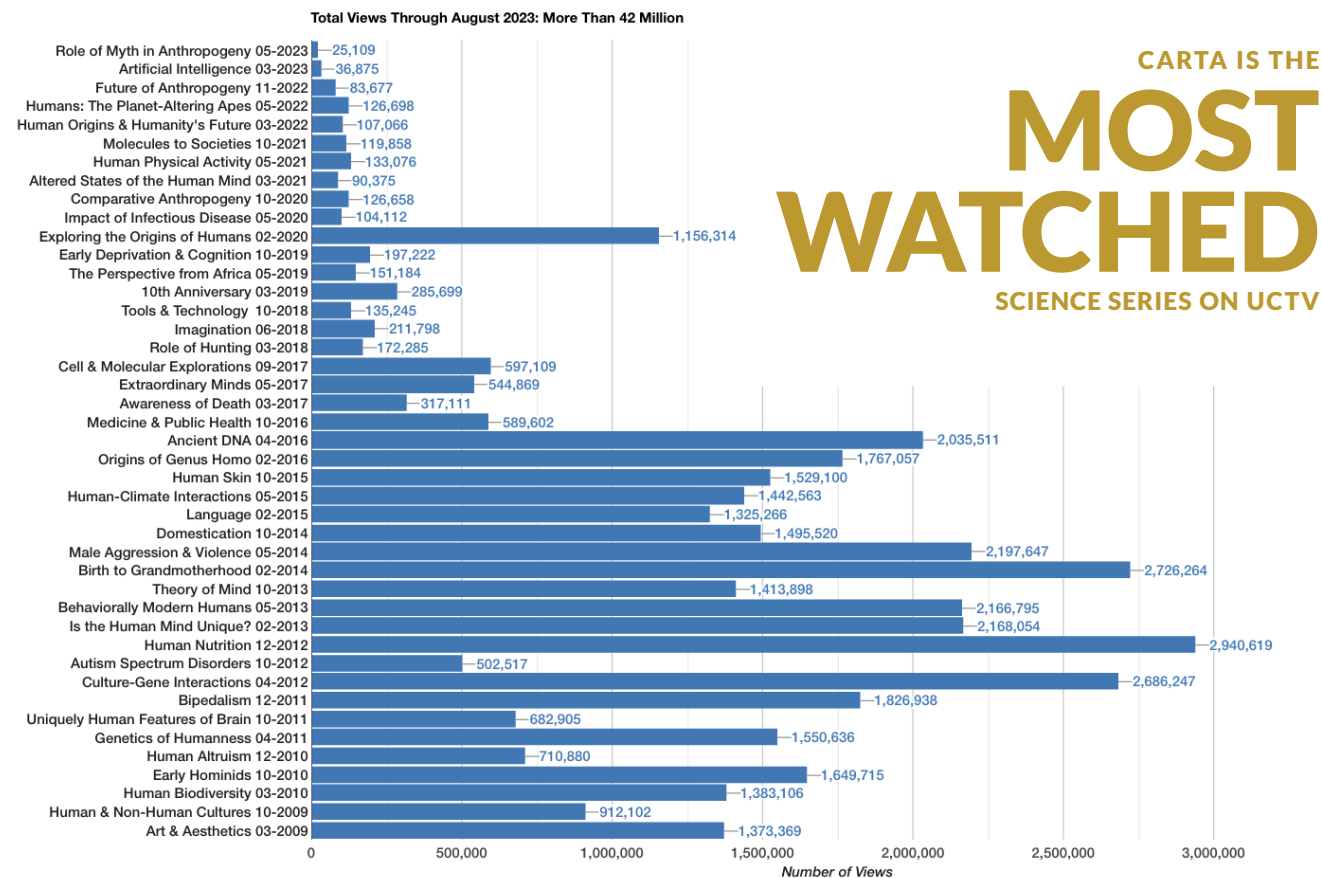


Special thanks to our partners for helping to achieve this remarkable milestone!



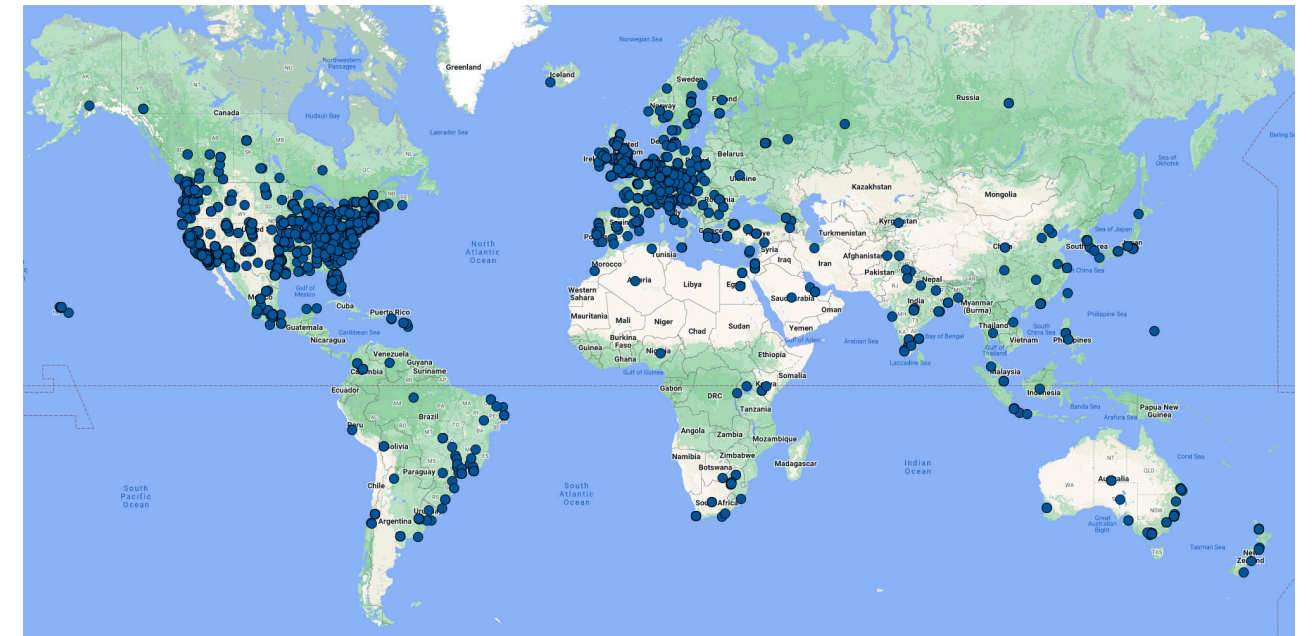
## Total Online Viewership 2009 to 2023

All CARTA symposia are video recorded by UCSD-TV, broadcast on the UCTV channel, and then archived on various websites (CARTA, UCSD-TV, iTunes, YouTube). By August 2023, the total number of views of CARTA videos and audio podcasts topped 42 million.



## Livestream Viewership

CARTA began livestreaming its symposia in 2012. The map below shows the location of ~10k live stream viewers from 80 countries and regions between October 2012 and August 2023.



## Symposium Sponsorships

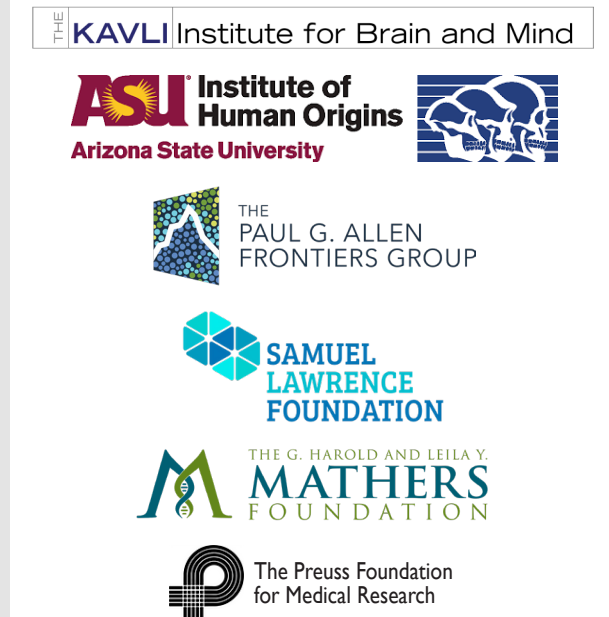
CARTA symposia have benefited from numerous funding and partnerships with interested individuals, foundations, and institutions.

### INDIVIDUAL SPONSORS

- Annette C. Merle-Smith\*
- Rita L.\* & Richard C. Atkinson
- Ingrid M. Benirschke-Perkins '79 & Gordon C. Perkins '82
- Benjamin N. Cipollini PhD '14
- Elizabeth C. Lancaster & Eli Shefter
- Feroza Ardeshir & Suresh Subramani
- John S. Armstrong III
- Kenneth Brown
- David E. Buccigrossi '79, MD '84 & Debra Buccigrossi '83
- Carolyn P. Farris
- David A. Fitz & Mary J. Fitz
- Kathlyn L. Furr
- Cheryl A. & Kenney Griffiths
- Robert C. Mashman
- Sue R. Rosner
- Oliver A. Ryder PhD '75
- Lawrence J. Schneiderman
- Robert Stavros

\* Deceased

### FOUNDATIONS and INSTITUTIONS





## Posters

Each CARTA symposium features a bespoke poster and accompanying graphics designed and produced in-house. The final designs result from key concepts derived by CARTA staff and through discussion with symposium co-chairs and speakers.



## Glossary

CARTA public symposia are interdisciplinary, and terminology may have different meanings across disciplines or may be unfamiliar. It is CARTA's goal to educate and stimulate the minds of academics, graduate and undergraduate students, and the general public.

To ensure that CARTA symposia are mutually intelligible for all, we produce and provide a glossary of terms for each event. Additionally, these glossary terms are compiled on the CARTA website as a peer-reviewed and searchable resource consisting of over 930 terms relevant to human origins.

### Sample CARTA Glossary Terminology - Ancient DNA and Human Evolution

<b>Adaptation:</b> Evolution of a phenotype by selection because it improved reproduction and/or survival.	<b>Gene Flow:</b> Movement of alleles between populations via mating.
<b>Allele:</b> Alternative DNA sequence at the same locus (location on the chromosome).	<b>Homology:</b> Similarity in DNA or phenotype because of shared evolutionary history from a common ancestor.
<b>Allele Frequency:</b> The proportion of all alleles within a population that are a particular type.	<b>Homoplasy:</b> Similarity in DNA sequence or phenotype that has evolved independently.
<b>Coalescence:</b> Time since common ancestor.	<b>Hybridization:</b> Breeding among recognized species.
<b>Coalescent Theory:</b> Models evolution backward in time to infer historical population size, mutation rate, allele age, and allele frequency change by selection and drift.	<b>Phylogeny:</b> Historical relationships of species or loci.
<b>Demography:</b> Study of population size over time.	<b>Polymorphism:</b> The "many forms," or genetic variants, of a single gene that exist and are maintained in a population at a frequency of 1% or higher.
<b>Divergence:</b> Change in genetic content or phenotype between isolated populations or species.	<b>Population:</b> A defined group of similar individuals among whom interbreeding occurs.
<b>Effective Population Size (<math>N_e</math>):</b> The size of an idealized population (random mating, no selection, mutation or migration) with the same rate of genetic drift as the study population.	<b>Selection:</b> Allele frequency change over time caused by the different replication rate of specific alleles.
<b>Genetic Drift:</b> Change in allele frequencies, including fixation and loss, by chance.	<b>Species:</b> A population whose individuals can mate with one another to produce viable and fertile offspring. (debated definition)

## IMPACT OF COVID

CARTA was able to respond to the constraints of the COVID pandemic by drawing on our decade-long experience livestreaming public symposia.

In May 2020, we organized a special symposium on the *Impact of Infectious Disease on Humans and our Origins* with speakers from UC San Diego Health Sciences, the Salk Institute for Biological Studies, and the La Jolla Institute for Immunology. Over the next three years, additional symposia took place virtually with speakers from several continents (Europe, Africa, Asia, and Australia). We have since transitioned to both in-person and virtual events.



## CARTA Members

A core component of CARTA is its membership, which consists of worldwide experts in a variety of academic and research fields who share a common interest in explaining the origins of humans. To date, there are over 400 active members from 148 disciplines and subdisciplines across 22 countries.

Members are invited by CARTA leadership based on their engagement in active research related to any aspect of human origins. CARTA symposia are the major pipeline for new members as most invited speakers for CARTA symposia are also invited to join CARTA's membership.

Members have access to all recorded discussion sessions from past symposia that follow each public event. Members are encouraged to network and explore new collaborations.

CARTA relies on its members for the proposal and organization of future symposia. The internal and external advisors are also drawn from the membership.

Scan the QR code to view the full list of CARTA members.



## Local Member List

### UC San Diego

- Michael Arbib (Psychology)
- Dhananjay Bambah-Mukku (Psychology)
- Patricia Churchland# [Emerita] (Philosophy)
- Thomas Csordas (Anthropology)
- James Fowler (Political Science)
- Keolu Fox (Anthropology)
- Jonathan Friedman [Emeritus] (Anthropology)
- Ralph Greenspan (Neurobiology)
- Christine Harris (Psychology)
- Robert Kluender (Linguistics)
- David Holway (Biological Sciences, Ecology, Behavior & Evolution)
- Donald MacLeod (Psychology)
- Maria Carolina Marchetto# (Anthropology)
- Therese Markow [Emerita] (Biological Sciences, Cell & Developmental Biology)
- Rachel Mayberry (Linguistics)
- James Moore [Emeritus] (Anthropology)
- Elizabeth Newsome (Visual Arts)
- Amy Non (Anthropology)
- Rafael Nunez (Cognitive Science)
- Carol Padden (Communication)
- David Perlmutter [Emeritus] (Linguistics)
- V.S. Ramachandran [Emeritus] (Psychology)
- Ramesh Rao (Electrical and Computer Engineering; Qualcomm Institute)
- Diane Rogers-Ramachandran (Psychology)
- Federico Rossano (Cognitive Science)
- Oliver Ryder (San Diego Wildlife Alliance; Biological Sciences-Ecology, Behavior & Evolution)
- Adena Schachner (Psychology)
- Margaret Schoeninger [Emerita] (Anthropology)
- Katerina Semendeferi (Anthropology)
- Nicholas Spitzer [Emeritus] (Biological Sciences-Neurobiology)
- Joan Stiles [Emerita] (Cognitive Science)
- Shirley Strum [Emerita] (Anthropology)
- Caren Walker (Psychology)
- Christopher Wills [Emeritus] (Biological Sciences-Ecology, Behavior & Evolution)

### Scripps Institution of Oceanography

- Jeff Severinghaus (Geosciences Research Division)
- Charles Kennel [Emeritus] (Atmospheric Sciences)
- Veerabhadran Ramanathan (Climate, Atmospheric Science, and Physical Oceanography)

### La Jolla Institute for Immunology

- Sujan Shresta (Center for Infectious Disease & Vaccine Research)

### UC San Diego – Health Sciences

- Andrew Baird (Surgery)
- Michael Baker (Medicine)
- Ellen Breen (Medicine)
- Eric Courchesne (Neurosciences)
- Pascal Gagneux\* (Pathology; Anthropology)
- Richard Gallo (Dermatology)
- Patricia Judd [Emerita] (Psychiatry)
- Rob Knight\* (Pediatrics; Computer Science & Engineering)
- Amanda Lewis (Obstetrics, Gynecology, & Reproductive Sciences)
- Alysson Muotri (Pediatrics; Cellular & Molecular Medicine)
- Caroline Nievergelt (Psychiatry)
- Victor Nizet (Pediatrics)
- Jerry Olefsky (Medicine)
- Barbara Parry (Psychiatry)
- Karen Pierce (Neurosciences)
- Manuela Raffatellu (Pediatrics)
- Robert (Chip) Schooley (Medicine-Infectious Disease)
- Jonathan Sebat (Psychiatry)
- Tatum Simonson (Medicine)
- Larry Squire [Emeritus] (Psychiatry)
- Palmer Taylor (Skaggs School of Pharmacy & Pharmaceutical Sciences)
- Ajit Varki# (Medicine; Cellular & Molecular Medicine)
- Nissi Varki (Pathology)
- John West (Physiology)
- Elizabeth Winzeler (Pediatrics)
- Nigel Woolf [Emeritus] (Surgery)

### Salk Institute for Biological Studies

- Fred Gage^ (Laboratory of Genetics)
- Roger Guillemin [Emeritus]
- Anthony Hunter^ (Molecular & Cell Biology)
- Gerald Joyce^ (Salk President; Chemical Biology & Proteomics)
- Susan Kaech^ (Immunobiology & Microbial Pathogenesis)
- John Reynolds^ (Systems Neurobiology)
- Terry Sejnowski^ (Computational Neurobiology)
- Paula Tallal [Adjunct Professor]

### The Scripps Research Institute

- Floyd Bloom [Emeritus] (Neuropharmacology)

#### LEGEND

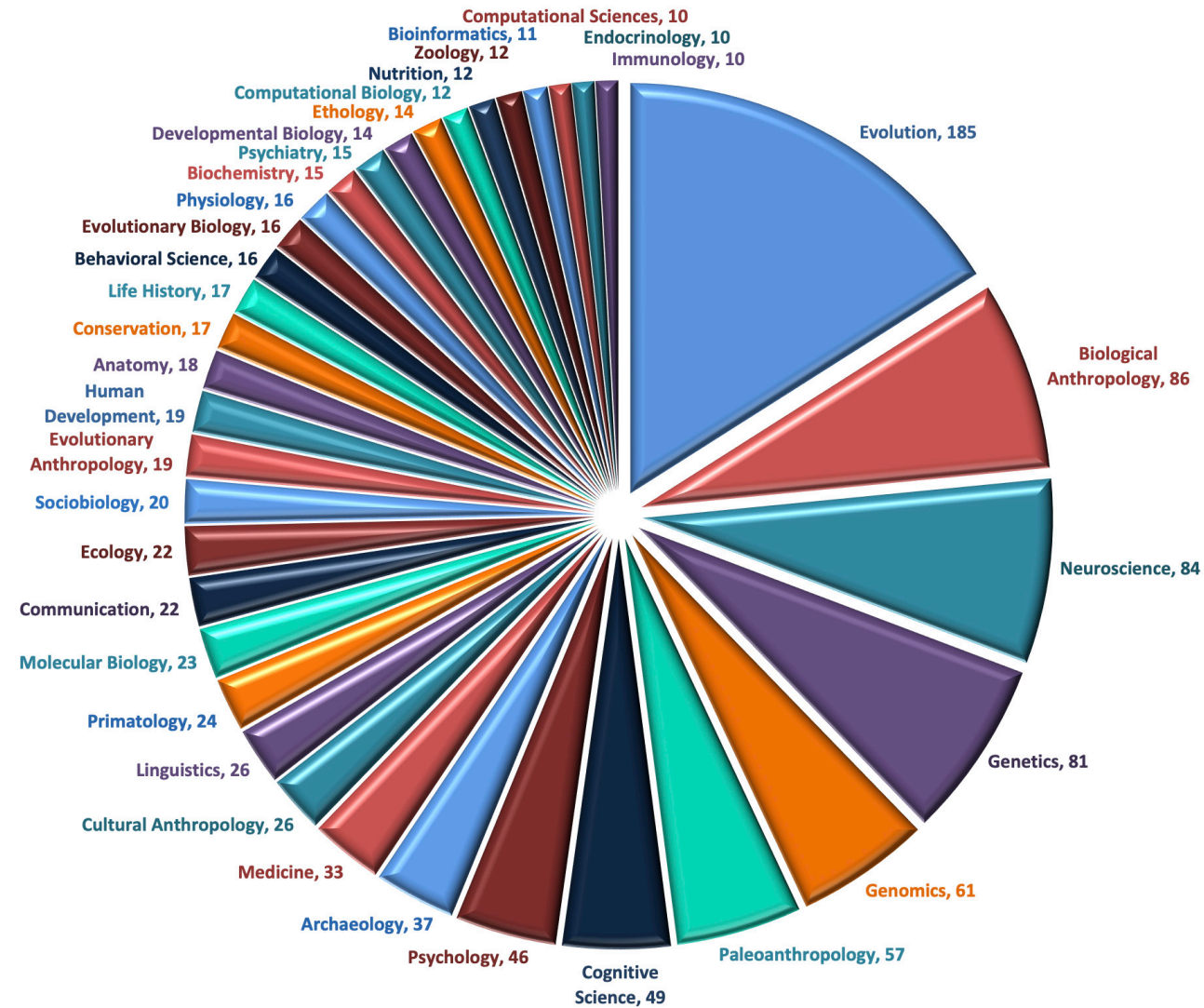
\* Joint appointments in UC San Diego and UC San Diego Health Sciences

# Salk Institute Adjunct appointment

^ UC San Diego Adjunct Appointment

## Member Expertise (148 Areas)

The graph below illustrates the top 36 areas of expertise shared by 10 or more CARTA members. Members may be included in more than one area.



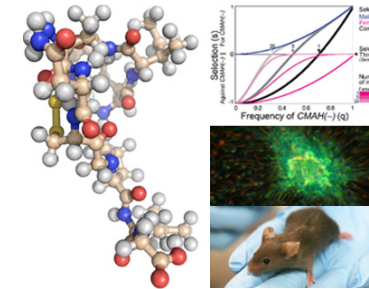
Scan the QR code to view the full list of areas of CARTA member expertise.



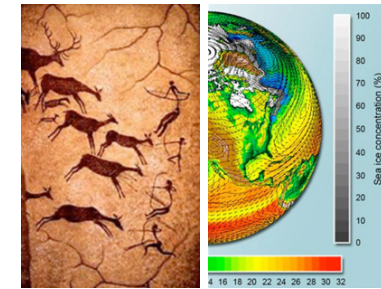
## Scales of Investigation

CARTA member expertise is vital to anthropogeny as exploring human origins requires investigations at many different spatial and temporal scales. These range from molecules to models, culture to climate, synapses to societies, and fossils to field primatology.

### Molecules to Models



### Culture to Climate



### Synapses to Societies



### Fossils to Field Primatology



## Member Locations

CARTA members live in 22 countries across the globe.



## Selected Member Comments

*"I don't know of anywhere else that provides such a stimulating multidisciplinary approach to the evolution and adaptation of the human species."*

**Leslie Aiello,**

Anthropologist, University College London



*"CARTA allowed me at a relatively early stage in my career to present my ideas surrounding the evolution of early Homo and to make connections across and outside my subdisciplinary area."*

**Susan Antón,**

Anthropologist, New York University



*"CARTA provides the opportunity for young and experienced researchers to understand the interplay between human origins and our evolutionary trajectories."*

**Yonas Beyene Gebremichael,**

Archeologist, French Research Center for Ethiopian Studies, Addis Ababa, Ethiopia



*"I've been enjoying the bold and cross-disciplinary nature of CARTA since well before becoming a member, thanks to the available materials online. I have used some of those materials in my own teaching."*

**Damián Blasi,**

Linguistics Cultural Evolution, Harvard University



*"Whenever it is necessary for my research and my teaching, I find in CARTA the latest research data in human paleontology. I am fortunate to find quality scientific articles on the CARTA site."*

**Abdoulaye Camara,**

Archeologist, Anta Diop University, Senegal



*"I found the integration of students with a diversity of research interests was conducive to developing new directions"*

**Michael Chazan,**

Archeologist, University of Toronto



*"CARTA thus is both humbling and utterly exhilarating – I rarely miss a meeting and value the meetings as well as the podcasts to follow."*

**Patricia Churchland,**

Philosopher, UC San Diego



*"CARTA has been invaluable in impacting my research career. Particularly as a junior scholar, the networking opportunities afforded to me through my association with CARTA are unparalleled."*

**Alyssa Crittenden,**

Nutritional Anthropologist, University of Nevada Las Vegas



*"CARTA has a very wide reach and serves as an excellent science education venue for students and the public writ large. The speakers are also carefully chosen experts with deep knowledge on the subject matter and well versed in presenting general public talks."*

**Yohannes Haile-Selassie,**

Paleoanthropologist, Arizona State University



*"I have witnessed the development of this unique endeavor of CARTA. CARTA has a multidisciplinary nature that attracts people to discuss the origins of human nature, cognition, and behavior."*

**Tetsuro Matsuzawa,**

Primatologist, California Institute of Technology



*"CARTA is a fundamental resource in the field of Anthropogeny (and indeed beyond that field). Not only does it provide valuable, state-of-the-art information, which would already be great, but it also constitutes an exciting forum of debate in which novel ideas and perspectives are being constantly born. If CARTA did not exist already, someone should have to invent it."*

**Arcadi Navarro,**

Evolutionary Genomics, Pompeu Fabra University, Spain



*"It has fueled my thinking on evolutionary questions and brought me into contact with ideas and researchers that have influenced my thinking and writing about the evolution of human musicality. I am especially appreciative of the way CARTA archives the videos of its meetings and makes the public-facing talks freely available online. These are an invaluable resource for research and teaching."*

**Aniruddh Patel,**

Music Cognition, Tufts University



*"I am continuously surprised by the things I learn through CARTA – things that I cannot believe I did not know previously."*

**Daniel Povinelli,**

Anthropologist, University of Louisiana at Lafayette



*"There's nothing like CARTA – certainly, there is no other professional meeting that has such a sharp focus on what it is that makes humans human."*

**Todd Preuss,**

Anthropologist/Neuroscientist, Emory University



*"CARTA symposia have been among the most intellectually stimulating conferences in my career. I also make extensive use of the recorded CARTA lectures in the classroom."*

**James Rilling,**

Anthropologist, Emory University



*"The exchange of information that occurs through presentations and conversations at CARTA events provides inspiration for new research directions and direct connections for collaborations."*

**Tatum Simonson,**

Geneticist, UC San Diego



*"CARTA creates value through networking and public outreach, bringing together world leaders in anthropogeny."*

**Stephen Stearns,**

Evolutionary Biologist, Yale University



*"Providing perspectives of uniquely human traits; Opportunity to examine cross-species commonalities; Broadening perspectives on cultural diversity that has driven human evolution."*

**Faraneh Vargha-Khadem,**

Cognitive Neuroscientist, University College London



*"I appreciate the symposia, both the public element and the 'closed door' portions during which scholars can interact."*

**Carol Ward,**

Anatomical Anthropologist, University of Missouri



*"What has been of greatest value to my work from these symposia is to be able to place research topics in the broader perspective of human phylogeny, ontogeny and both universality of certain behaviors as well as the wide range of cultural expressions."*

**Polly Wiessner,**

Anthropologist, Arizona State University & University of Utah



*"CARTA is a venue that truly values and promotes interdisciplinary work. I've not seen a format like the CARTA symposia anywhere else, with such high-impact speakers. Thank you!"*

**Eva Wittenberg,**

Linguist, Central European University, Vienna



Scan the QR code to view the full list of CARTA member comments.





## Member Collaborations

The following transdisciplinary collaborations resulted from member interactions facilitated by CARTA symposia, and it illustrates the breadth of topics and disciplines involved in human origins explorations.

### Alyssa Crittenden & Peter Ungar

Topic: *Hadza dentition and oral health.*

- Crittenden, A., et al. (2017). The Hadza foragers of Tanzania. *PloS one*, 12(3), e0172197.
- Ungar, P. S., et al. (2019). Dental microwear of living Hadza foragers. *American Journal of Physical Anthropology*, 169(2), 356-367.

### Aniruddh Patel & Alyssa Crittenden

Topic: *Music of the Hadza people of Tanzania.*

- This collaboration amongst a member of the Hadza community, an ethnomusicologist, and a composer is the first scholarly study of the music of the Hadza people. Significantly, this project also serves to archive the music of the community for future generations of Hadza people.

### Arcadi Navarro, Evan Eichler, Philipp Khaitovich, William Hopkins, Kenneth Kidd, Joshua Akey, Katherine Pollard, Todd Preuss, Carlos Bustamante, & Chet Sherwood

Topic: *Genome evolution.*

- Gao H, et al. (2023). The landscape of tolerated genetic variation in humans and primates. *Science*, 380(6648).

### Barry Bogin, Sarah Hrdy, & Sue Carter

Topic: *The physiology of "love" (The biocultural importance of secure social relationships with other people).*

### Berhane Asfaw & Lyn Wadley

Topic: *Early hominids from South Africa, Chad, Ethiopia and other countries.*

- Co-chaired CARTA symposium, *Anthropogeny: The Perspective from Africa* (May 2019).

### Chris Stringer, Juan Luis Arsuaga, Katerina Harvati, John Hawks, & Jean-Jacques Hublin.

Topic: *Comparing the Boxgrove and Atapuerca (Sima de los Huesos) human fossils.*

- Lockey, AL, et al. (2022). Comparing the Boxgrove and Atapuerca (Sima de los Huesos) human fossils: Do they represent distinct paleodemes? *Journal of Human Evolution*, 172(103253).

### Chris Stringer, Michel Brunet, Katerina Harvati, John Hawkes, & Jean-Jacques Hublin

Topic: *Frontal sinuses and human evolution.*

- Balzeau, A., et al. (2022). Frontal Sinuses and Human Evolution. *Sci Adv.*, 8(42).

### Sarah A Tishkoff & Chris Stringer

Topic: *Human origins in Southern African palaeo-wetlands.*

- Schlebusch, C.M., et al. (2021). Human origins in Southern African palaeo-wetlands? Strong claims from weak evidence. *Journal of Archaeological Science*, 130(105374).

### Katerina Harvati & Chris Stringer

Topic: *Apidima Cave fossils.*

- Harvati, K., et al. (2019). Apidima Cave fossils provide earliest evidence of Homo sapiens in Eurasia. *Nature*, 571(7766), 500-504.

### Ellen Breen & Pascal Gagneux

Topic: *Micro level oxygen transport mechanisms in elite diving mammals: Capillary RBC to myofiber.*

- Funding recommendation: National Science Foundation, Integrative Research in Biology (IntBIO).

### Ellen Breen & Ajit Varki:

Topic: *Human-like Cmah inactivation in mice increases running endurance.*

- Okerblom, J., et al. (2018). Human-like Cmah inactivation in mice increases running endurance and decreases muscle fatigability: implications for human evolution. *Proc Biol Sci*, 285(1886), 20181656.

### Fred Gage & Carol Marchetto

Topic: *Studies on the cell and molecular mechanism of neuronal neoteny.*

### Fred Gage & Ajit Varki

Topic: *Role of glycobiology in neuronal development and evolution.*

### Fred Gage & Pascal Gagneux

Topic: *Extracellular matrix and Alzheimer's Disease.*

### James Sikela & several CARTA investigators

Topic: *Genetic and genomic features unique to the human lineage.*

- O'Bleness, M., et al. (2012). Evolution of genetic and genomic features unique to the human lineage. *Nat Rev Genet.* 13(12), 853-66.

### Jon Kaas, Todd Preuss, James Rilling, Bernard Wood, Pasko Rakic, Barry Bogin, Michael Arbib, & John Allman

Topic: *The evolution of nervous systems.*

- Kaas, J.H., et al. (2007). *Evolution of Nervous Systems: A Comprehensive Reference, First Edition, Four Volume Set.* Netherlands: Elsevier.
- Kaas, J.H., et al. (2016). *Evolution of Nervous Systems: A Comprehensive Reference, Second Edition, Four Volume Set.* Netherlands: Elsevier.

**Jean-Pierre Changeux & Jean-Jacques Hublin**

Topic: *The neurogenetics of recent stages of hominization in the past 100,000 years.*

- Hublin, J.-J., & Changeux, J.-P. (2022). Paleoanthropology of cognition: an overview on Hominins brain evolution. *Comptes Rendus Biologies*, 345(2):57-75.

**John Vincent Moran, Carol Marchetto, Alysson Muotri, & Fred Gage:**

Topic: *Line 1 retrotransposition in the nervous system.*

- Coufal, N.G., et al. (2011). Ataxia telangiectasia mutated (ATM) modulates long interspersed element-1 (L1) retrotransposition in human neural stem cells. *PNAS*, 108(51):20382-20387.

**Joseph Hacia & Oliver Ryder**

Topic: *Induced pluripotent stem cells.*

- Ramaswamy, K., et al. (2015). Derivation of induced pluripotent stem cells from orangutan skin fibroblasts. *BMC Res Notes*, 8(1).

**Joshua Akey, Ajit Varki, & Pascal Gagneux**

Topic: *Analysis of patterns of human genetic variation in Siglec genes.*

- Saha, S., et al. (2022). Evolution of Human-Specific Alleles Protecting Cognitive Function of Grandmothers. *Mol Biol Evol*, 39(8).

**Joshua Akey & Tony Capra**

Topic: *Testing hypotheses about the phenotypic consequences of DNA sequences inherited from Neanderthal ancestors.*

- Simonti, C.N., et al. (2016). The phenotypic legacy of admixture between modern humans and Neandertals. *Science*, 351(6274):737-41.

**Patricia Churchland & Frans De Waal**

Topic: *Evolution of morality.*

- de Waal, F., Churchland, P.S., Pievani, T., & Parmigiani, S. (Eds). (2014). Evolved Morality: The biology and philosophy of human conscience. In *Evolved Morality: The biology and philosophy of human conscience*. BRILL.

**Martin Rees & Charlie Kennel**

Topic: *Climate change.*

**Susan Anton & Leslie Aiello**

Topic: *Human Biology and the Origin of Homo.*

- Anton, S.C., Potts, R., & Aiello, L.C. (2014). Evolution of early *Homo*: An integrated biological perspective. *Science*, 345(6192).

**Nigel Woolf & Pascal Gagneux**

Topic: *Cave navigation.*

- Experimental design of a new CARTA-inspired study of cave navigation and exploration by early hominids.

**Ruslan Medzhitov & Stephen Stearns**

Topic: *Evolutionary medicine.*

- Stearns, S.C., & Medzhitov, R. (2015). *Evolutionary Medicine*. Sunderland: Sinauer Associates, Inc.

**Timothy Tangherlini & Erich Jarvis**

Topic: *The neurogenic basis of vocal learning.*

- Exchange of trainees and grant proposals.

**Rafael Nuñez & Pascal Gagneux**

Topic: *Biological enculturation.*

- Co-taught undergraduate seminars on “Biological Enculturation” at UC San Diego.

**Todd Preuss, James Rilling, & William Hopkins**

Topic: *MRI studies of primate brains.*

- Use of comparative MRI studies of humans, chimpanzees, and macaque monkeys to identify human specializations of cortical network organization.

**Wieland Huttner & Svante Pääbo**

Topic: *Cortical development in humans and Neanderthals.*

- Pinson, A., et al. (2022). Human TKTL1 implies greater neurogenesis in frontal neocortex of modern humans than Neanderthals. *Science*, 377.6611:eabl6422.
- Mora-Bermúdez, F., et al. (2022). Longer metaphase and fewer chromosome segregation errors in modern human than Neanderthal brain development. *Science Advances*, 8.30:eabn7702.

**Tim Weaver & Brenna Henn**

Topic: *Human origins in Africa.*

- Ragsdale, A.P., et al. (2023). A weakly structured stem for human origins in Africa. *Nature*, 617(7962), 755-763.

**Tetsuro Matsuzawa & Dora Biro**

Topic: *Field experiment of stone tool use by Bossou chimpanzees in Guinea.*

- Koops, K., et al. (2023). Appropriate knowledge of wild chimpanzee behavior ('know-what') and field experimental protocols ('know-how') are essential prerequisites for testing the origins and spread of technological behavior. *Animal Behavior and Cognition*, 10(2):163-168.

**Terrence Sejnowski & Patricia Churchland**

Topic: *Machine learning and A.I.*

- Co-chaired the CARTA symposium, *Artificial Intelligence and Anthropogeny* (March 2023).

**Tatum Simonson & Keolu Fox**

Topic: *Human high-altitude adaptation.*

- Hall J.E., et al. (2020). Seq-ing Higher Ground: Functional Investigation of Adaptive Variation Associated With High-Altitude Adaptation. *Front Genet*, 11:471.

**Eva Wittenberg, Erich Jarvis, & Terrence Sejnowski**

Topic: *Language evolution.*

- Submitted a joint Simons Foundation grant application.

“CARTA’s interdisciplinary interactions have also inspired many other collaborative research projects and publications that illustrate human uniqueness. Examples include studies of Hadza microbiomes and dental health; explorations of when humans started standing upright and started running (long-distance running being another thing that humans do that chimpanzees don’t); how random genomic duplications might lead to evolutionary advantages; and how humans might have “self-domesticated” by collectively selecting against certain types of aggression.”

- Heather Buschman, *This Week at UC San Diego*, February 2022

## CARTA-Inspired Publications

CARTA encourages transdisciplinary research to advance our understanding of human origins through its symposium series and resulting interactions. CARTA symposia provide a forum for researchers in varied fields to come together “to explore and explain the human phenomenon.” Member interactions continue after symposia and via the CARTA website. Below is a sample of selected 2022-2023 publications inspired by such interactions. Since CARTA’s inception, there have been over 1,000 publications, with over 100 in the last three years.



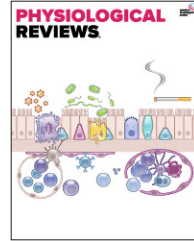
Kuderna, L.F.K., et al. (2023). A global catalog of whole-genome diversity from 233 primate species. *Science*, 380(6648):906-913.



Ragsdale, A.P., et al. (2023). A weakly structured stem for human origins in Africa. *Nature*, 617(7962):755-763.



Koops, K., et al. (2023). Appropriate knowledge of wild chimpanzee behavior ('know-what') and field experimental protocols ('know-how') are essential prerequisites for testing the origins and spread of technological behavior. *Animal Behavior and Cognition*, 10(2):163-168.



Vaill, M., Kawanishi, K., Varki, N., Gagneux, P., & Varki, A. (2023). Comparative physiological anthropology: exploring molecular underpinnings of distinctly human phenotypes. *Physiol Rev*, 103(3):2171-2229.



Moussaoui, B., Overcashier, S.L., Kohn, G.M., Araya-Salas, M., & Wright, T.F. (2023). Evidence for maintenance of key components of vocal learning in ageing budgerigars despite diminished affiliative social interaction. *Proc Biol Sci*, 290(2000):20230365.



Pagkrati, I., et al. (2023). Genomic characterization of HLA class I and class II genes in ethnically diverse sub-Saharan African populations: A report on novel HLA alleles. *HLA*, 102(2):192-205.



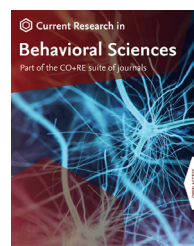
Caglayan, E., et al. (2023). Molecular features driving cellular complexity of human brain evolution. *Nature*, 620(7972):145-153.



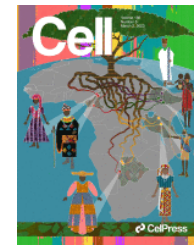
Ruebens, K., et al. (2023). Neanderthal subsistence, taphonomy and chronology at Salzgitter-Lebenstedt (Germany): a multifaceted analysis of morphologically unidentifiable bone. *Journal of Quaternary Science*, 38:471-487.



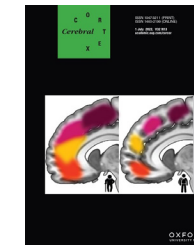
Achorn, A., et al. (2023). Reciprocity and beyond: Explaining meat transfers in savanna-dwelling chimpanzees at Fongoli, Senegal. *Am J Biol Anthropol*, 182(2):224-236.



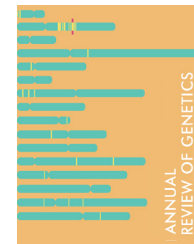
Arbib, M.A., Fragaszy, D.M., Healy, S.D., & Stout, D. (2023). Tooling and Construction: From Nut-Cracking and Stone-Tool Making to Bird Nests and Language. *Current Research in Behavioral Sciences*, 5:100121.



Fan, S., et al. (2023). Whole-genome sequencing reveals a complex African population demographic history and signatures of local adaptation. *Cell*, 2023;186(5):923-939.



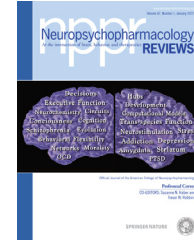
Ardesch, D., et al. (2022). Scaling Principles of White Matter Connectivity in the Human and Nonhuman Primate Brain. *Cerebrum*, 32(13):2831-2842.



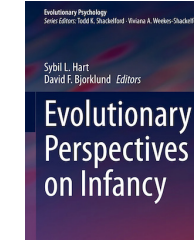
Whalen, S. & Pollard, K.S. (2022). Enhancer Function and Evolutionary Roles of Human Accelerated Regions. *Annu Rev Genet*, 56:423-439.



Saha, S., et al. (2022). Evolution of Human-Specific Alleles Protecting Cognitive Function of Grandmothers. *Mol Biol Evol*, 39(8).



Preuss, T.M., & Wise, S.P. (2022). Evolution of prefrontal cortex. *Neuropsychopharmacology*, 47(1):3-19.



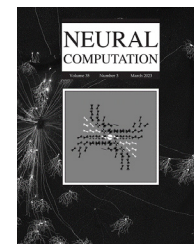
Hrdy, S.B., & Burkart, J.M. (2022). How reliance on allomaternal care shapes development with special references to the genus Homo. In: Hart, S.L., Bjorklund, D.F., eds. *Evolutionary Perspectives on Infancy*. New York: Springer, 161-188.



Pinson, A., et al. (2022). Human TKTL1 implies greater neurogenesis in frontal neocortex of modern humans than Neanderthals. *Science*, 377(6611):eabl6422.



Zhang, C., et al. (2022). Impact of natural selection on global patterns of genetic variation, and association with clinical phenotypes, at genes involved in SARS-CoV-2 infection. *PNAS*, 119(21).



Sejnowski, T. (2022). Large Language Models and the Reverse Turing Test. *Neural Comput*, 35(3):309-342.



Mora-Bermúdez, F., et al. (2022). Longer metaphase and fewer chromosome segregation errors in modern human than Neanderthal brain development. *Sci Adv*, 8(30):eabn7702.



Joshi, R.S., et al. (2022). Look-alike humans identified by facial recognition algorithms show genetic similarities. *Cell Rep*, 40(8):111257.



Whiteley, J.T., et al. (2022). Reaching into the toolbox: Stem cell models to study neuropsychiatric disorders. *Stem Cell Reports*, 17(2):187-210.



Dr. Pascal Gagneux instructs students participating in the Graduate Specialization in Anthropogeny.

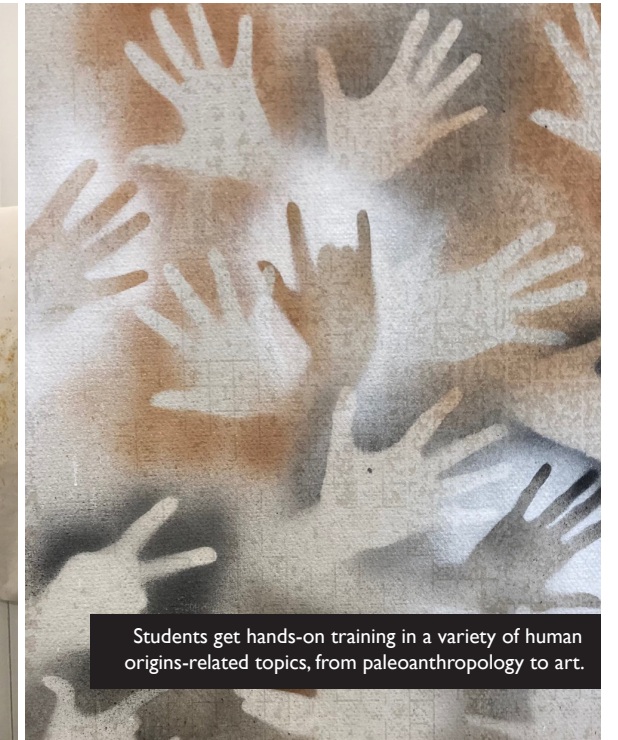
## The Graduate Specialization in Anthropogeny

In 2009, the Graduate Specialization in Anthropogeny was established for UC San Diego doctoral students with interest in human origins. The specialization provides students from eight participating PhD programs the opportunity to obtain a parenthetical degree in research and education on explaining the human phenomenon. Students gain valuable training in transdisciplinary research spanning the social and natural sciences. Participating students complete a curriculum of courses on human origins, participate in scientific symposia and ensuing discussions, network with researchers from around the world, and “cross-train” with peers from a variety of disciplines. A few of these courses are also open to graduate students from any discipline at UC San Diego.

**Demand:** Scientific disciplines continue to expand their respective bodies of knowledge and the capacity to understand and integrate scientific findings from widely differing fields of research is an increasingly important skill. The study of human origins is a key example of a research endeavor that critically relies on such integration skills. The Graduate Specialization in Anthropogeny aims to equip future scientists, researchers, and scholars with the necessary interdisciplinary skills and panoramic perspective needed for advancing our understanding of human origins.

**Market Needs:** Areas as disparate as medicine, public health, environmental policy, and marketing have come to increasingly rely on evolutionary approaches to observe human phenomena. Public and private sectors alike have an increasing need for individuals with scientific training accompanied by an understanding of natural and social sciences, as well as arts and humanities, and the capacity to translate findings from these different areas for specialists and the public at large.

**Placement Opportunities:** Transdisciplinary training greatly benefits students as they embark on future careers in public or private sectors where the capacity to mediate between different types of knowledge bases is increasingly important. Whether their future careers are in teaching, basic research, industry, public service, or private enterprise, the capacity to work with findings from a variety of disciplines will make alumni of the Graduate Specialization in Anthropogeny valuable assets for employers (see “Where are they now,” page 36).



Students get hands-on training in a variety of human origins-related topics, from paleoanthropology to art.

## Program Requirements

Students participating in the Graduate Specialization in Anthropogeny are required to take the following courses:

**Introduction to Anthropogeny ANTH 203 (4 credits):**  
*Lecture; graduate elective course open to all graduate students at UC San Diego; serves as the core course for the biological anthropology program.*

**Advanced Anthropogeny BIOM 229 (2 credits):**  
*Seminar; only for Specialization students.*

**Current Topics in Anthropogeny (BIOM218):**  
*Lecture; conjoined with CARTA symposia; Specialization students are required to participate in at least six CARTA symposia.*

Specialization students are encouraged to participate in the following optional meeting and elective course:

**Anthropogeny Research Rounds (monthly):**  
*Journal discussion meeting; highlights relevant human origins research.*

**Anthropogeny Field Course in Tanzania (ANTH289S):**  
*A three-week Summer Session course in Tanzania. Students experience field research, the ecological context of human adaptation, and the four major approaches to studying the origins of our species (fossil evidence, archeology, comparative biology, and ethnography of human foragers).*

### GOAL OF THE SPECIALIZATION

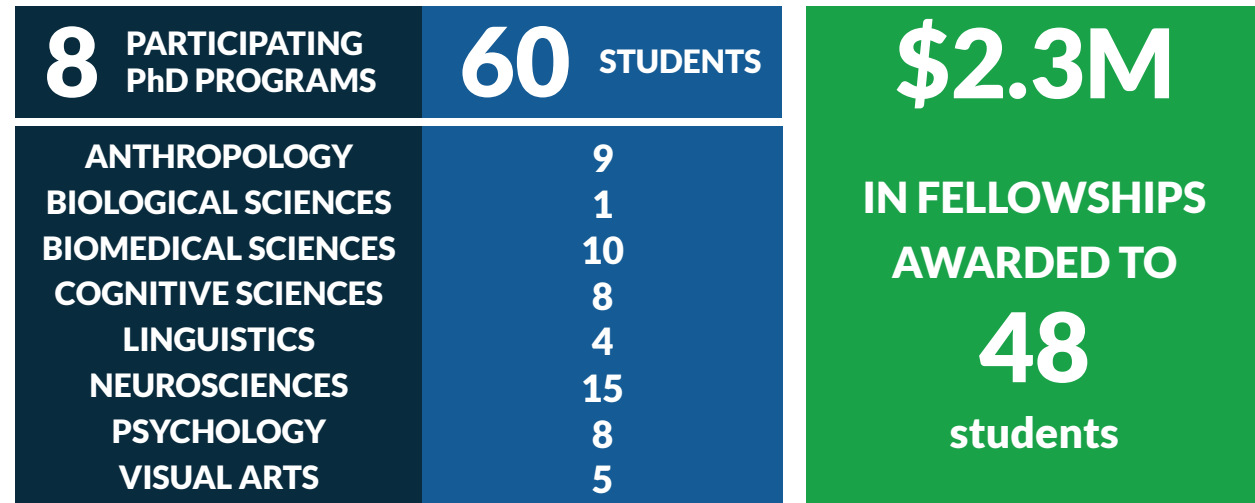
To provide a broad and explicitly transdisciplinary approach spanning the social and natural sciences by focusing on one of the oldest questions of humankind: the origins of humans and humanity.

### THE BROAD TOPIC AREAS

- Human and Primate Genetics and Evolution
- Paleoanthropology and Hominid Origins
- Mammalian and Primate Neurosciences
- Primate Biology and Medicine
- Language and Cognition
- Nature-Nurture Interactions in Explaining Language and Cognition
- Human and Primate Society and Culture
- Comparative Developmental Biology of Primates
- General Theories for Explaining Humans



## Program Statistics



## Fellowships

CARTA offers the **Anthropogeny Graduate Fellowship Program**. This competitive fellowship program is open to actively participating students. This donor-funded program is currently in its 14th year, with support pledged for two more years.

















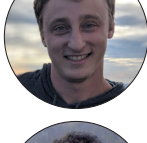



- 5-6 individual fellowships awarded each year
- \$20,000/each, a maximum of three years of support per student, for stipend and/or tuition and fees
- Students can devote more time to completing the three-year specialization program and their own PhD program's requirements, and less time on seeking other funding sources.

CARTA offers two fellowship opportunities.

- 1) **The Annette C. Merle-Smith Fellowship** honors the late Annette C. Merle-Smith, who was a supporter of CARTA from the beginning. This fellowship was established to support the participation of those students who demonstrate the most involvement in, and commitment to, the Graduate Specialization in Anthropogeny.
- 2) **CARTA Fellowships**, supported by an Anonymous donor, are awarded to other high-performing and deserving Graduate Specialization in Anthropogeny students.

CARTA ANTHROPOGENY FELLOWSHIPS AWARDED (BY PROGRAM) - 2010-2024						
GRADUATE PROGRAM	SCHOOL	# AWARDS	# STUDENTS	FUNDING AWARDED		
				BY PROGRAM	BY SCHOOL	% OF TOTAL
Visual Arts	Arts & Humanities	11	5	\$ 220,000	\$ 220,000	9%
Biological Sciences	Biological Sciences	2	1	\$ 40,000	\$ 40,000	2%
Anthropology	Social Sciences	17	7	\$ 469,979	\$ 1,627,289	71%
Cognitive Science		24	9	\$ 572,623		
Linguistics		8	4	\$ 195,672		
Psychology		20	10	\$ 389,015		
Biomedical Sciences	Medicine	8	4	\$ 154,746	\$ 404,697	18%
Neurosciences		11	8	\$ 249,951		
		<b>101</b>	<b>48</b>		<b>\$ 2,291,986</b>	

## Current Students

	<b>Felix Binder:</b> Cognitive tools of humans and artificial intelligences. <b>Cognitive Science</b>		<b>Shubhra Murarka:</b> Health outcomes among historically excluded communities and demographic histories using genetic and interdisciplinary methods. <b>Anthropology</b>
	<b>Patrick Bruck:</b> Brain development from an evolutionary perspective. <b>Biomedical Sciences</b>		<b>Nicholas Nelson:</b> Crosstalk between immune and nervous systems in the context of neurological and neurodegenerative diseases. <b>Biological Sciences</b>
	<b>Mika Caplan:</b> Signaling pathways that regulate GPCR-mediated Hippo pathway activation in invasive breast cancer. <b>Biomedical Sciences</b>		<b>Coral Pereda:</b> Relationships between brain imaging technologies, AI and mythmaking through the lens of contemporary art. <b>Visual Arts</b>
	<b>Julia Gorman:</b> Visual cortex of primates, discerning differences between self-locomotion and object motion. <b>Neurosciences</b>		<b>Chantal Rabay:</b> Associations between maternal perceived stress, anxiety, and depression and microRNA (miRNA) expression in human breast milk. <b>Anthropology</b>
	<b>Stephanie Holden:</b> The meaning of "human" across varying cultural contexts, and factors predicting attribution of humanity of others. <b>Psychology</b>		<b>Meghan Rossi:</b> Lifestyle factors such as diet and exercise affect the function and gene expression of the blood-brain barrier. <b>Neurosciences</b>
	<b>Juston Jaco:</b> Potential biomarkers of red meat consumption to establish dietary factors linked to the progression of chronic diseases. <b>Biomedical Sciences</b>		<b>Hande Sever:</b> History of artistic practices in Turkey, focusing on a group of artists who established the movement known as Anatolian Humanism. <b>Visual Arts</b>
	<b>Kendall Kearns:</b> Immune signatures of unconventional T cells across the spectrum of tuberculosis infection. <b>Biomedical Sciences</b>		<b>Sheila Steiner:</b> Changes in neuronal energy metabolism across primate evolution in development and aging. <b>Neurosciences</b>
	<b>Lora Khatib:</b> Computational modeling of microbial cells in the body and their influence on neurotransmitter regulation and neuroinflammation. <b>Biomedical Sciences</b>		<b>Yaohan Wu:</b> Zoonotic diseases in neolithic Northwest China. <b>Anthropology</b>
	<b>Reid Larsen:</b> Distinct glycocalyx of the blood brain barrier. <b>Biomedical Sciences</b>		<b>Anne Yilmaz:</b> Facial perception, recognition, memory, and decision-making tasks. <b>Psychology</b>
	<b>James Michaelov:</b> Experimental and computational methods to study the neurocognitive underpinnings of language in humans. <b>Cognitive Science</b>		<b>James Yu:</b> Genetic and physiological variation in high-altitude populations with adaptation to low oxygen environments. <b>Biomedical Sciences</b>

# IN THE FIELD



"I will remember this trip for the rest of my life, and I will remember things about the science and philosophy of human origins better than I ever could from a presentation or paper. I got to learn by doing. Doing with field experts. Doing with hunter gatherers. Doing with chimpanzees in their own habitat."  
 - Nicholas Nelson, PhD Candidate, Biological Sciences, UC San Diego

## Anthropogeny Field Course

In 2011, CARTA developed a unique human origins Summer Session field course for UC San Diego students in the Graduate Specialization in Anthropogeny. This optional three-week course immerses students in field research, the ecological context of human adaptation, and the four major approaches to studying the origins of our species (fossil evidence, archeology, comparative biology, and ethnography of human foragers). To date, 46 students have participated. Primary study is held at locations throughout Tanzania but, depending on the year, there are additional sessions at the National Museum in Ethiopia or the Atapuerca cave system in Spain. The sessions in Ethiopia and Spain provide exposure to world-renowned fossil hominins and mammalian remains that provide key ecological context for understanding hominin evolution. CARTA's partnership with the Greater Mahale Ecosystem Research and Conservation (GMERC) has also introduced graduate students to the reality of primatological field research firsthand. Participants have found the anthropogeny field course to be profoundly life-changing.



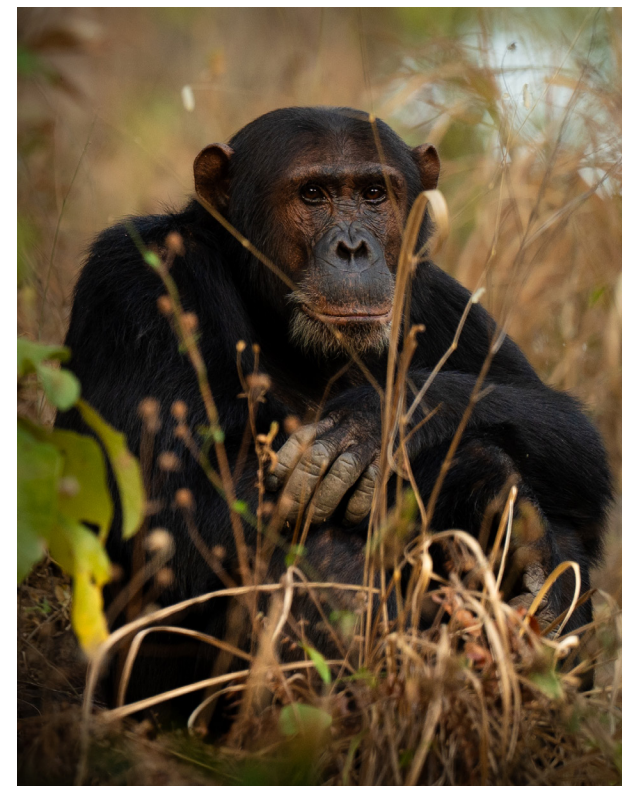
## Partnership with GMERC

The Greater Mahale Ecosystem Research and Conservation (GMERC) Project is a Tanzania-based group that leads scientific investigation into primate behavior, ecology, and conservation. Although GMERC was incorporated in 2017, its efforts to better understand chimpanzees, baboons, and red-tail monkeys living in a savanna mosaic habitat date back to 2008 when long-term research was initiated in Issa Valley, Tanzania.

In 2011, the principal investigators of what is now GMERC, Dr. Fiona Stewart and Dr. Alex K. Piel PhD '14, proposed a partnership, whereby CARTA would provide annual overhead support in exchange for GMERC's organization, facilitation, and participation in the annual Anthropogeny Field Course. This partnership has provided Graduate Specialization in Anthropogeny students with diverse experiences in how human origins research is approached, from the study of analogous Plio-Pleistocene modern East African landscapes (Serengeti and Ngorongoro), to the behavioral ecology of contemporary hunter-gatherers (the Hadza) and humans' closest living relatives (wild chimpanzees). Not only does GMERC organize and facilitate these activities, but it also hosts the students at its field station in Issa Valley for primatological sessions.

With CARTA's support, GMERC has grown from two foreign researchers and three Tanzanian field assistants to a permanent, year-round research project with a team of fifteen researchers and assistants. GMERC leads investigation into primate behavioral ecology with troops of three habituated primate species. GMERC plays a key role in our broader understanding of human origins by way of studying animals that live in a similarly dry, mosaic habitat to that of key early hominins (e.g., *Ardipithecus ramidus*). Project data also provide important information regarding the evolution of bipedalism, cranio-anatomical biomechanics of primate feeding ecology, and habitat use.

In addition to hosting Graduate Specialization in Anthropogeny students and CARTA members, GMERC offers Tanzanian and international students, interns, researchers, and collaborators an opportunity to explore their own interests in human origins through the study of extant primates in the Rift Valley. The GMERC-CARTA partnership strengthens Tanzanian scientists' capacity for studying wild primates with the dual goal of informing human evolution and the conservation of these threatened species.



## Selected Student Comments

Current Graduate Specialization in Anthropogeny students, along with those who have graduated, many of whom were CARTA Anthropogeny Graduate Fellowship recipients, were asked to provide feedback about the value of their affiliation with CARTA and how it has influenced their intellectual progress and research. These comments reflect the many ways CARTA and the Graduate Specialization in Anthropogeny benefit UC San Diego's graduate students.

*As an international student I was not eligible for most graduate fellowships, but CARTA saw the value in me and my research and provided funding that helped me focus my time on my research projects.*

**Tanushree Agrawal** PhD '23  
Psychology



*CARTA took me out of my very narrow field of focus and reminded me about the scope of research as a whole. My Ph.D. research can feel very isolating and insignificant at times, and CARTA has been able to connect me to other Ph.D. students and faculty from departments that are completely different from my own.*

**Mika Caplan** PhD Candidate  
Biomedical Sciences



*CARTA was a critical cog in my professional experience and remains a key touch-point with the University now that I am out of academia. Any UC San Diego donations would be focused on CARTA.*

**Ben Cipollini** PhD '14  
Cognitive Science



*CARTA's courses, meeting, and symposia provided me with an unparalleled opportunity to share my own research and consider questions of human evolution from a multi-disciplinary perspective. This approach, synthesizing ideas from multiple lines of research, was also important to my dissertation.*

**Emily Davis** PhD '23  
Linguistics



*In addition to contributing to my scientific perspective, CARTA was "home" for me as a graduate student; through CARTA I found mentorship, relationships, and inspiration that was essential to my success as a graduate student; and therefore, a fundamental component of my continued career as a scientist.*

**Whitney Friedman** PhD '17  
Cognitive Science



*I strongly recommend that all incoming students give serious consideration to participating in the specialization as it enables students to approach their coursework and research studies with a broader historical perspective and importance.*

**Anupam Garg** PhD '19, MD '21  
Neurosciences



*This interdisciplinary environment enables me to explore the evolutionary implications of glycobiological processes in the context of human development, offering insights into the molecular mechanisms that underlie the distinct features of human evolution.*

**Juston Jaco** PhD Candidate  
Biomedical Sciences



*The opportunity CARTA provides for interdisciplinary cross pollination is invaluable. When so many academic fields are siloed off from each other, CARTA brings the discussion into a single room. I can think of no other single academic program that effectively brings everyone together to address a topic as difficult and diverse as human origins.*

**Stephen Johnston** PhD '19  
Neurosciences



*It is such a unique program and has brought more purpose to my Ph.D. and it has challenged me intellectually more than I ever have been before. It's humbling and a huge privilege to interact with and learn from some of the brightest minds in the world on a topic that is so fundamental to who we are as humans.*

**Reid Larsen** PhD Candidate  
Biomedical Sciences



*Thank you for offering this program - it was by far the most enriching and thought-provoking part of my time at UC San Diego.*

**Emily Little** PhD '17  
Psychology



*I think the strongest impact CARTA made on me was that it helped shift my focus from my narrow Ph.D. topic to see how it fit within the broader conversation surrounding human evolution.*

**Corinna Most** PhD '18  
Anthropology



*My worldview has been broadened through CARTA and its members, and I have learned so much through going through the coursework and particularly the symposia. I've also appreciated meeting and hearing from those in the humanities as well as natural sciences. This is definitely a unique place.*

**Shubhra Murarka** PhD Candidate  
Anthropology



*CARTA has been the single most intellectually engaging, academically diverse, and downright fun experience of my graduate education. It has significantly enhanced my ability to engage with my field's own literature, particularly in trying to tease apart what aspects of human cognition and pathologies we are \*actually\* studying when using mouse models. CARTA brings together world experts from so*

*many fields, and allows us students to interact with them in ways that are unparalleled in any of the opportunities offered by my home department.*

**Nicholas Nelson** PhD Candidate  
Biological Sciences



*CARTA made a huge impact on my experience as a PhD student. It allowed me to take my general scientific knowledge and apply it beyond my narrow research question to sweeping philosophical questions about what it means to be human. It was instrumental in introducing me to a network of people with vastly different backgrounds (e.g. art, anthropology) who challenged me to think about my research and anthropogeny from a new perspective.*

**Catie Profaci** PhD '22  
Neurosciences



*CARTA was critical to my PhD studies - from the perspective of my academic growth, personal development, and overall enjoyment. I was surrounded by creative, smart, and engaging scientists at all career stages and from all different disciplines.*

**Andrew Schork** PhD '16  
Cognitive Science



*Having the privilege to be part of the Graduate Specialization in Anthropogeny informed my research in invaluable ways, helping me to further develop my capacity to understand and integrate scientific knowledge, as well*

*as to mediate between different types of knowledge bases in order to further develop my interdisciplinary dissertation research that brings together the fields of art history and anthropogeny.*

**Hande Sever** PhD Candidate  
Visual Arts



*The most important element of research is what questions we choose to ask. CARTA begins every symposium by emphasizing some of the biggest questions pervading human existence.*

**Michael Vaill** PhD '21  
Biomedical Sciences



*This program and its cross-disciplinary nature have yielded some of the most fundamental experiences I have had as a graduate student, and I hope this program will continue on for many, many years to come. Two years of fellowship funding, which has granted me countless hours of much needed time to dedicate toward my research. I also cannot stress enough how impactful the field course in Africa was in terms of gaining and solidifying Anthropogeny content knowledge, experiencing firsthand accounts from field researchers, which could not be matched by reading any textbook or research article.*

**Katie Van Alstyne** PhD Candidate  
Psychology



## Selected Student Comments, Continued

Being trained to look at research through an evolutionary lens made me realize that this framework is deeply lacking in the applied domain of my field --- and that's turned into a paper in-prep.

**Anne Yilmaz** PhD Candidate  
Psychology



CARTA has played a fundamental role in my development as an academic throughout my PhD. It has exposed me to new ideas regarding human evolution that I have then applied to my PhD research. It has also connected me with scholars from all around the world and other PhD students on UCSD's campus.

**James Yu** PhD Candidate  
Biomedical Sciences



Through CARTA, I felt I had a home within the larger UCSD community, and the international community as well.

**Rachel Zarndt** PhD '16  
Biomedical Sciences



The points of view of other CARTA students and faculty in regular research rounds have refined my own ways of thinking about the academic work on cultural evolution; this refinement has continued through the CARTA symposia and seeped into my own academic work.

**Matt Zaslansky** PhD Candidate  
Linguistics



Scan the QR code to view the full list of student comments.



## STUDENT INVOLVEMENT IN SYMPOSIA

Synthesizing insights based on data from outside one's own field of study is a primary skill the Graduate Specialization in Anthropogeny seeks to develop in students. This is achieved through student participation in CARTA symposia, which bring together eminent researchers from diverse areas of expertise to present on relevant human origins topics. Students "shadow" the symposium speakers, engage in ensuing discussion sessions, and submit written summaries of the speakers' presentations. They also present at symposium "preview" and "digest" meetings led by Anthropogeny faculty. This provides students with rich opportunities to participate in scientific conferences as peers, meet "scientific heroes" within and outside their respective fields, and expand their knowledge base.



Graduate Specialization in Anthropogeny students and speakers at the November 2023 CARTA symposium, *Comparative Anthropogeny and Other Approaches to Human Origins*.

## Where are they now?

The 42 UC San Diego graduate students who have completed the Graduate Specialization in Anthropogeny have moved onto a range of positions in academia, medicine, non-governmental organizations, government, and industry. The following is a brief overview of the current achievements of 25 of the graduates:



**Melanie Beasley** PhD '16  
Assistant Professor, Biological Anthropology,  
Purdue University



**Whitney Friedman** PhD '17  
Interdisciplinary Marine Scientist,  
UC Santa Cruz



**Landon Klein** PhD '18  
Director of U.S. Policy, Future of Life Institute



**Tim Sainburg** PhD '21  
Postdoctoral Fellow, Harvard University



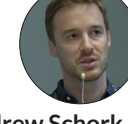
**Emily Verla Bovino** PhD '17  
Assistant Professor, Art History,  
York College, City University of New York



**Anupam Garg** MD '21, PhD '19  
Resident Physician,  
Wilmer Eye Institute, Johns Hopkins Medicine



**Caroline Lew** PhD '18  
Postdoctoral Fellow,  
UCSF Weill Institute for Neurosciences



**Andrew Schork** PhD '16  
Research Leader, Copenhagen University Hospital



**Alie Caldwell** PhD '19  
Medical Writer,  
Health & Wellness Partners, LLC;  
Co-creator and Host, Neuro Transmissions



**Kiri Hagerman** PhD '18  
Production Editor, Annual Reviews



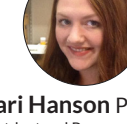
**Emily Little** PhD '17  
Founder, Executive Director, Nurturely



**Nina Semushina** PhD '17  
Postdoctoral Scholar, University of Chicago



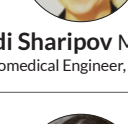
**Ben Cipollini** PhD '14  
Founding AI Engineer, Galileo AI



**Kari Hanson** PhD '17  
Postdoctoral Research Fellow,  
UC Davis MIND Institute



**Hope Morgan** PhD '17  
Guest Researcher,  
Leiden University, Netherlands



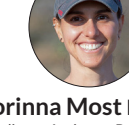
**Heidi Sharipov** MEng '16  
Sr. R&D Biomedical Engineer, Canary Medical



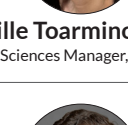
**Leela Davies** MD '15, PhD '13  
Associate Director, Translational Sciences,  
BioNTech SE



**Jeremy Karnowski** MS '12  
Principal, Technical Training, TetraScience



**Corinna Most** PhD '18  
Adjunct Assistant Professor,  
Iowa State University



**Camille Toarmino** PhD '17  
Data Sciences Manager, Snapdocs



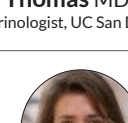
**Kyle Fischer** PhD '18  
Senior Scientist, Gene Therapy Research,  
Neurocrine Biosciences



**Megan Kirchgessner** PhD '21  
Postdoctoral Fellow,  
New York University School of Medicine



**Sequoyah Reynoso** PhD '18  
Adjunct Professor,  
Carroll Community College



**Robert Thomas** MD '16, PhD '14  
Endocrinologist, UC San Diego Health



**Rachel Zarndt** PhD '16  
Grants and Agreements Management, USDA

## Matrix of Comparative Anthropogeny (MOCA)

### MOCA ORIGINS AND RATIONALE

The Matrix of Comparative Anthropogeny (MOCA) started as a simple list of features allegedly unique to humans compiled by Ajit Varki (Founding Executive Co-Director of CARTA and Distinguished Professor of Medicine and Cellular and Molecular Medicine at UC San Diego). With the establishment of CARTA came the opportunity to expand and correct this list, which has grown to over 600 topics across 24 scientific domains.

MOCA attempts to collect existing information currently scattered in the literature about human-specific differences from great apes (O'Bleness et al., 2012; Vaill et al. 2023). Having such information in one location could lead to new insights and multidisciplinary interactions, and to ethically sound studies to explain differences, as well as distinctly-human specializations. MOCA is called a matrix for this reason. This approach will hopefully allow us to connect the dots among different distinctly-human traits and shed light on

how and in what sequence these have evolved. Furthermore, it may allow us to connect different specializations and potentially discover which may have caused others. Importantly, such a chronology will be very helpful in ruling out certain scenarios due to inconsistencies in timing.

MOCA is organized into 24 different domains based on areas of scientific knowledge, and each topic is assigned to the domain it most closely relates to. Topics are cross-listed with others across all domains when warranted. For example, the entry on "composition of milk" in the MOCA domain, *Biochemistry*, is cross-listed with blood group antigens (*Pathology*), domestication (*Behavior*), duration of lactation (*Development*), parental investment (*General Life History*), sialic acid content of the brain (*Neuroscience*), difficulty in breast-feeding, breast development without pregnancy/lactation (*Reproductive Biology and Disease*), and with microbiome (*Ecology*).

## Comparative Anthropogeny (COMP/ANTH)

### AN OPEN-ACCESS, ONLINE COMPENDIUM OF DISTINCTLY HUMAN FEATURES

The Comparative Anthropogeny (CompAnth) project is an open access, online, and peer-reviewed resource compiling all known or suspected features that appear distinct to the human species. Humans present a paradoxical constellation of "biologically enculturated" characteristics (intertwined biological and cultural inheritance) with no parallel among extant species. It is poorly understood how, why, when, and in what order these distinctly-human features evolved. Currently, there is no available peer-reviewed resource that compiles all known or suspected human-specific features.

CompAnth will address this deficiency and bridge remaining gaps in knowledge. This resource will facilitate the generation of practical insights for navigating the many challenges posed by the Anthropocene, the current period of human-driven planetary changes. These changes include threats to biodiversity, unstable human migration



patterns, changing fertility rates, aging populations, conflicts between different cultures, global food production, aging populations, and human impacts on global climate.

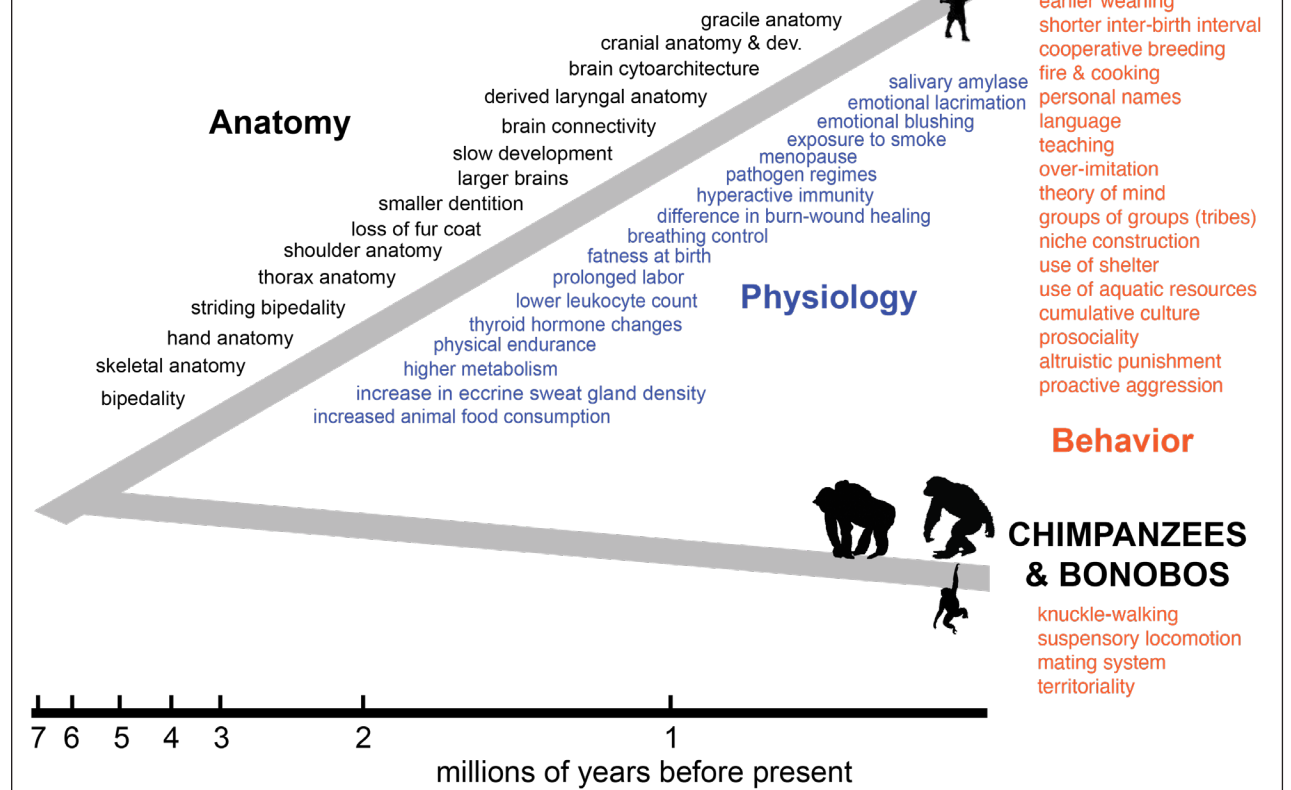
CompAnth will be published through the National Library of Medicine (NLM) and its realization will be accompanied by regular public symposia on selected topics targeted to broad audiences of scholars, students, and interested public.

The scaffold for CompAnth is MOCA (see previous). Existing MOCA entries will undergo review and

revision prior to CompAnth publication while new topics will be assigned to authors by the Editorial Board (see next page).

CARTA will develop and manage the editorial process IT infrastructure (author/editor interface, web portal workflows) and curate the publication of CompAnth through the NLM. Publication on the NLM website will ensure its stability for decades to come.

## Examples of Distinctly Human Traits



The evolutionary lineage leading to modern humans accumulated a large number of distinctly derived traits with regard to anatomy, physiology, and behavior. From: Vaill, M., Kawanishi, K., Varki, N., Gagneux, P., & Varki, A. (2023). Comparative physiological anthropology: exploring molecular underpinnings of distinctly human phenotypes. *Physiol Rev*, 103(3):2171-2229.

As new knowledge becomes available, revisions of MOCA and CompAnth will be handled by editors and chapter authors.

CompAnth Editorial Staff and Editorial Board:

- **Editor-in-Chief:** Pascal Gagneux, Executive Co-Director of CARTA (expertise in evolutionary biology and comparative molecular primatology).
- **Senior Editor:** Ajit Varki, founder and executive Co-Director Emeritus of CARTA (expertise in medicine and biology).
- **Science Editor:** Jesse Robie, CARTA Program Coordinator (expertise in biological anthropology).
- **Editorial Board:** MOCA Domain leaders.

Scan the QR code to learn more about MOCA.



## Museum of Primatology (MOP)

CARTA maintains unique and invaluable skeletal and data collections, which make up its Museum of Primatology (MOP). These collections consist of skeletons, associated veterinary samples, and records of chimpanzees (Primate Foundation of Arizona Collection - PFA) and macaques (Gavan Collection). The basic data contained within these collections have great relevance to anthropogeny and allow researchers to address questions concerning the origins of our lineage through comparative primatology. Collection data are maintained on the CARTA website and freely available for researchers around the world to utilize upon request and submission of a research proposal. Thus far, 55 requests for access have been granted and our collections have contributed to numerous anthropogeny-related studies.

<b>2</b> PRIMATE COLLECTIONS	<b>55</b> RESEARCH REQUESTS
<b>52 CHIMPANZEE SKELETONS</b>	<b>46 INSTITUTIONS</b>
<b>&gt; 100 CHIMPANZEE SERA SAMPLES</b>	<b>12 COUNTRIES</b>
<b>68 CHIMPANZEE VETERINARY SUMMARIES</b>	
<b>89 MACAQUE SKELETONS</b>	
<b>137 MACAQUE RECORDS</b>	



### PRIMATE FOUNDATION OF ARIZONA (PFA) COLLECTION

In July 2008, CARTA received the donation of 52 chimpanzee skeletons (adult and subadult) and veterinary data, including longitudinal blood sera samples of 89 chimpanzees and their veterinary records, that were ethically and meticulously collected over three decades by the Primate Foundation of Arizona (PFA). PFA was a nonprofit corporation whose primary goal was to improve the care and management of captive chimpanzees using results from studies conducted at the facility.



### GAVAN COLLECTION

The collection consists of skeletal materials of rhesus macaques (*Macaca mulatta*), from a long-term (1958-1972) growth study directed by the late James A. Gavan, Professor of Anthropology at the University of Missouri, Columbia. The collection contains 89 skeletons, 15 lab books detailing growth records on the 117 animals included in the study, ~6,000 radiographs, and dental casts showing eruption sequences.

## CURATION PROJECT

CARTA staff, assisted by UC San Diego students and volunteers, extensively curated the chimpanzee and macaque collections to ensure all materials were properly cleaned and preserved (both their physical state and provenance), that all determinable characteristics were assessed and recorded (species, sex, age, bone, bone side, pre- and post-mortem modification, storage wear, etc.), and that they were properly inventoried, cataloged, and securely stored in archival boxes in environmentally controlled conditions.

The entire PFA chimpanzee skeletal collection and some Gavan collection macaques were digitized through computed tomography (CT) scanning with assistance from collaborators at UC San Diego's Medical Center and the San Diego Supercomputer Center.

In addition, MOP staff and San Diego Supercomputer Center programmers developed a proprietary digital database system with all necessary data fields required to record information derived from analysis. Upon completion of curation and analysis, all relevant information and materials were uploaded to the database, and MOP established access and use policies for researchers.

Curation efforts of the PFA Collection have led to:

- Cataloging of the 52 physical subjects (representing 10,039 bone objects), including analysis, preservation, and proper storage.

- Summarization of all veterinary records, which include compiled information from ~60,000 numerical and narrative pages of data, results from diagnostic tests (x-rays, ultrasounds, biopsies, cultures, etc.), serum hematology and chemistry tests, and necropsy data, if available. For many individuals, both the samples and associated records span all of the animal's developmental stages and continue well into adulthood (>20 years).

Curation efforts of the Gavan Collection have led to:

- Cataloging of 89 physical subjects, including analysis, preservation, and proper storage.
- Digital scanning of 137 subject records, which contain detailed longitudinal (entire life history of the subject) and biological (anthropometry, morphology, etc.) information for each subject.
- Dental cast identification and curation (>1,000 plaster dental casts for numerous subjects throughout their lives).

CARTA acknowledges the generous support for this project by the late Annette C. Merle-Smith.



Detailed preparation of the Museum of Primatology (MOP) chimpanzee skeletal material (far left) was required to ensure efficient and consistent placement inside the Computed Tomography (CT) machine (top left). Once scanned, the digital information for each skeleton was processed into an image (below left). Because CT scanning records a plethora of information, the digital skeletons can be manipulated in space, measured, and even "cut" into slices to examine interior aspects.



## PUBLIC ENGAGEMENT

An important aspect of CARTA's mission is to "explore and explain the human phenomenon" while raising awareness and understanding of the study of human origins within the academic community and the public at large. These activities have taken a variety of forms and are the core of CARTA's local and global community engagement.

In support of CARTA's symposia, which attract local and international audiences, public outreach and engagement is aimed at bolstering their visibility and appeal to academics and the lay public, as well as generating a greater online presence.

Marketing of CARTA symposia is through traditional and online media outlets. Symposium co-chairs have appeared on San Diego's *KPBS Midday Edition* to promote the event and to provide important context to listeners who may also attend a symposium. Announcements are shared through a range of San Diego's print and digital publications and calendars (e.g., *Eventbrite*, *KPBS*, *La Jolla Light*, *San Diego Magazine*, *San Diego Reader*, *San Diego Union-Tribune*).

Direct contact with interested departments/groups at UC San Diego is also made through targeted email campaigns (Department of Anthropology, Alumni Association, Chancellor's Associates, Emeriti Association, Osher Lifelong Learning Institute, York Society, etc.).



CARTA also engages with other local academic institutions/schools (including community colleges) and like-minded organizations (e.g., Sanford Consortium for Regenerative Medicine, La Jolla Institute for Immunology, Sanford-Burnham Medical Research Institute, The Scripps Research Institute, San Diego Museum of Us, and San Diego Botanic Garden).

Interested local retirement communities (e.g., Vi at La Jolla Village, Wesley Palms) livestream or rebroadcast CARTA's symposia on site, enabling their residents to view the talks.

Marketing beyond the San Diego region targets relevant institutions of higher learning, professional communities, and scientific societies (e.g., American Anthropological Association [AAA], American Association of Biological Anthropologists [AABA], Arizona State University Institute of Human Origins [ASU IHO], Eastern Africa Association for Palaeoanthropology and Palaeontology [EAAPP], Kavli Science and Society).

CARTA announcements are also shared broadly through our social media platforms (see right) and by symposium speakers and their institutions.

-  [carta.anthropogeny.org](https://carta.anthropogeny.org)
-  [carta-info@anthropogeny.org](mailto:carta-info@anthropogeny.org)
-  [cartaucsd](#)
-  [ucsdcarta](#)
-  [ucsdcarta](#)
-  [cartaucsd](#)

## CARTA's Informal Learning Offerings

Engaging with and educating interested minds provides CARTA an opportunity to showcase the value anthropogeny has for humanity. Below is a sample of our educational outreach efforts.

### OSHER LIFELONG LEARNING INSTITUTE

Since 2013, CARTA has partnered with UC San Diego's Extended Learning's Osher Lifelong Learning Institute to offer biannual "Master Classes" on a range of anthropogeny-related topics. One-hour lectures are followed by question-and-answer periods moderated by Osher's coordinator.

- 5 CARTA Master Classes
- 25 CARTA Master Class Lectures
- 15 CARTA Member Speakers
- ~75 attendees per CARTA Master Class



Carol Marchetto (CARTA Internal Advisor and UC San Diego Professor of Anthropology) presents at an Osher Master Class.

### CHANCELLOR'S ASSOCIATES COLLOQUIUM

On May 3, 2023, CARTA was featured by UC San Diego's Chancellor's Associates Colloquium series, which is a philanthropic activity geared toward an audience of prominent UC San Diego alumni and special guests. CARTA Executive Co-Director, Pascal Gagneux, presented *Anthropogeny: Explaining the Origins of the Planet-Altering Ape*, demonstrated a range of artifacts, and engaged with the lively audience. CARTA thanks David E. Buccigrossi '79, MD '84, Chair of the Chancellor's Associates Scholarship Program (CASP), and a longtime CARTA supporter, for the invitation and opportunity to share our passion for human origins, as well as to showcase the unique value CARTA adds to the University's philanthropy and outreach.



Pascal Gagneux (CARTA Executive Co-Director and UC San Diego Professor of Anthropology and Pathology) was the featured speaker at the May 3, 2023 Chancellor's Associates Colloquium.

### PALOMAR COLLEGE "ANTHROPOLOGY DAYS"

CARTA participated in the 2023 Palomar College "Anthropology Days" at the invitation of longtime CARTA Anthropogeny Affiliate, Parag Chowdhury, Assistant Professor of Anatomy, Palomar College, San Marcos, CA. Lindsay Hunter, CARTA's Community Engagement and Advancement Director, presented a keynote talk on her human origins research experiences in South Africa and jointly hosted an information table with UC San Diego Anthropology Club President, Declan Healy, and Vice-President, Reina Perez Munoz.



UC San Diego Anthropology Club's Declan Healy and Reina Perez Munoz at the information table.

## CARTA Rap Videos

CARTA commissioned Event Rap to produce educational anthropogeny videos, provided much of the content, and was engaged in the creative process with each artist.

Scan the QR code to watch.



"CARTA"

Baba Brinkman (Event Rap founder) tells the story of the CARTA.



"I'M HUMAN"

Baba Brinkman unpacks the findings and unanswered questions of Anthropogeny.



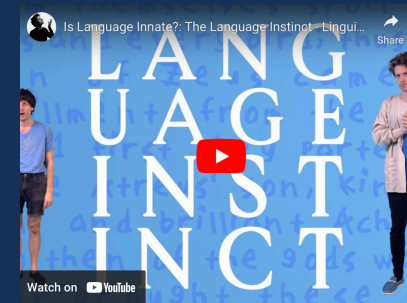
"THE GRANDMOTHER HYPOTHESIS"

Dizzy Senze raps about human grandparental care and the evolution of big brains.



"HEALTHY HOMINIDS"

MC ZEPS addresses evolutionary medicine.



"LANGUAGE INSTINCT"

Nathan Dufour explores language as the most diagnostic of human traits.



"CAVEMEN TO SPACEMEN"

Mega Ran explores lessons from the past applicable to the future.



## General Public Comments

Although CARTA originally grew from an academic impulse, it became evident that the value of its mission is important to the public and crosscuts segments of both local and global human societies. These select comments demonstrate the diverse ways the public appreciates CARTA and its content.

**Vivek Babu, Chennai, India**

*"...Several thematic lectures really shaped my thought process and my research choices and importantly stood as the guardrail in guiding my personal perspectives and views that are essential for humanistic thinking. As a long-term remote participant of CARTA, I wish the services of CARTA to continue for the welfare of researchers across the world."*

**William Bechtel, San Diego, California, United States**

*"CARTA serves multiple important functions, from providing a public forum for discussions of issues related to human origins to educational opportunities for students and information on its rich website. It is an asset for the University, the San Diego community, and the world."*

**Marjorie Carlson, Kirkland, Washington, United States**

*"I am just a layperson who really loves learning about human evolution and the species that preceded us. Even as a kid I checked out all the library books I could on the topic, but they were all decades out of date. CARTA's videos have given me the kind of access to new research and perspectives that I've always dreamed of..."*

**Philip De Barros, San Diego, California, United States**

*"As a Palomar Community College professor of anthropology, I supported the CARTA program by providing extra credit to my students in biological and cultural anthropology as well as archaeology to attend CARTA symposia..."*

*Some of the students who attended were impressed with UC San Diego and the CARTA program and some later applied and attended UC San Diego as undergraduates."*

**John Fogelvik, Delsbo, Sweden**

*"I have many times recommended CARTA to people both offline and online, adding that it is my favorite academic institution. The multidisciplinary approach is extremely important to me and what I cite to others as one of the top reasons to go look through past symposia..."*

**Declan Healy, San Diego, California, United States**

*"CARTA provides a great deal of value towards and training and encouragement of anthropogeny students (like myself) ... CARTA provides a beautiful online library of resources available to burgeoning prospective anthropogeny students/researchers to aid in their learning of such an advanced topic often not covered in the normal school curriculum for most majors."*

**Rachelle McCalla, Atlantic, Iowa, United States**

*"I find CARTA to be valuable for providing information, news, and new insights in the field of human origins. This is an area of research that has always fascinated me, but it's also an area of research steeped in myth and mystery, so I appreciate that CARTA takes it seriously and provides scientific rigor to the discussion."*

*"...Studying our evolution and development should make us better humans. This endeavor, and studying the fundamental physical properties of the universe, are the foundational scientific pursuits of our time."*

- David Buccigrossi '79, MD '84  
Chair, Chancellor's Associates, UC San Diego



**Sheila Mishra, Pune, India**

*"...I am a palaeolithic archaeologist, but many topics are out of my direct expertise and it is easier to understand their findings from the talks rather than their academic papers. These programs are not only valuable for the general public but also for experts in related fields."*

**Kathleen Ragan, Alexandria, Virginia, United States**

*"...It is so valuable to have a space in which scholars can push the boundaries of traditional thinking and effectively present interdisciplinary ideas. As we begin to understand the depth of connection and interdependence between biology, culture, and the physical and social worlds, CARTA serves as a much needed, trailblazing unifier."*

**João Ricardo Rebuge Pereira, Marco de Canaveses, Portugal**

*"To know ourselves and our background is essential to construct a better future for our Human Community. The goals of CARTA are essential to understand our place and to define our future steps. To know the best we can about our past and origins is the best way to achieve a better Future Destiny."*

**Jose Rene M. Sansait, Philippines**

*"CARTA provides me with the opportunity to update my knowledge about human evolution. I really appreciate that this endeavor is free, but more so, I admire the dedication and eagerness of the people behind it and of the contributors or panelists to so many relevant topics of my interest. Thank you."*

**Arnie Schoenberg, San Diego, California, United States**

*"CARTA provides excellent Anthropogeny lectures with world-renowned speakers and high-quality but digestible content. I teach at a community college feeder school and CARTA also serves to introduce prospective transfer students to UC San Diego."*

**Pete Swan, Cornwall, United Kingdom**

*"I learn best through YouTube (stroke survivor) and CARTA is maybe the best in the world for video content, prolific, always understandable, always great quality film and audio... All amazing that it's all free to view to anyone interested in where they came from."*

**Amie Webster, Wilmington, Delaware, United States**

*"I love this program. It expands my horizons and enriches my life."*

**Harshada Yadav, San Diego, California, United States**

*"The symposiums organized by CARTA have been a treat to me. I feel, after each one, I return with rekindled curiosity and awe (and the energy to work towards understanding) how marvelous it is to be humans."*

Scan the QR code to view more general public comments.





A long exposure light painting with the Milky Way as seen from Yaeda Valley, Tanzania, 2023

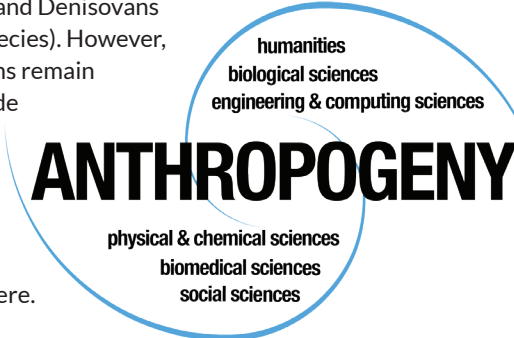
## The Value of CARTA

What started as an improbable, purely academic, and intellectual venture, has grown into an international effort to explain and explore the origin of humans, share knowledge with a global audience, and provide precious educational opportunities for graduate students across General Campus and Health Sciences at UC San Diego.

Our species is the planet-altering ape. A better understanding of our origins promises important insights into human nature, how it evolved in the biocultural context of prehistory, and how it may facilitate or constrain the many urgently needed solutions to profoundly existential challenges at local and global scales. CARTA provides a unique, transdisciplinary scaffold for this important endeavor.

## New Insights and Remaining Questions

We have learned many important details about human origins over the last few decades. Stone tools were being made in Africa before the appearance of the genus *Homo*. Fire use is older than our species, *Homo sapiens*. Modern humans originated in Africa but only recently expanded across the globe where some populations exchanged DNA with Neanderthals and Denisovans (archaic hominin species). However, many basic questions remain unanswered (see side bar). CARTA will continue to pursue these questions by drawing on expertise from the disciplines shown here.



## Future Efforts

### SYMPOSIA

Upcoming CARTA symposia are currently planned for 2024:

- *Body Modification: Anatomy, Alteration, and Art in Anthropogeny* (February 2024)
- *Lucy 50th Anniversary Symposium: The Impact of "Lucy" on Human Origins* (April 2024). See below.

### PARTNERSHIP WITH ASU

In October 2016, CARTA partnered with the Arizona State University (ASU) Institute of Human Origins to co-sponsor the CARTA Symposium, *Implications of Anthropogeny for Medicine and Health*.

This partnership was further strengthened by the addition of Yohannes Haile-Selassie, Director of the Institute of Human Origins, to CARTA's external board of advisors in 2022.

CARTA is co-sponsoring the Institute of Human Origins' April 2024 event on the 50th anniversary of the discovery of "Lucy" (*Australopithecus afarensis*). The event is organized by the Institute, while CARTA provides editing and distribution of the recorded presentations through UCTV.

### FUNDRAISING

CARTA is actively pursuing funding opportunities to continue its programs by:

- deepening relationships with current donors;
- cultivating new individual donor and corporate sponsorships; and
- seeking grant and foundation support.

## When did our lineage first start to...

use clothing or footwear?



believe in the supernatural?



think about the mind of others?



use spoken language?



teach children?

use symbols?

use personal names?

use projectile weapons?

make fire?

make music?

make ropes and baskets?

use home bases?

form pair bonds?

stride bipedally?





UC San Diego



Center for Academic and Training  
in Anthropogeny (CARTA)  
University of California San Diego  
9500 Gilman Drive MC 0060  
La Jolla, CA 92093-0060  
Phone: 858-246-0846

- [carta.anthropogeny.org](http://carta.anthropogeny.org)
- [carta-info@anthropogeny.org](mailto:carta-info@anthropogeny.org)
- [cartaucsd](https://twitter.com/cartaucsd)
- [ucsdcarta](https://www.facebook.com/ucsdcarta)
- [ucsdcarta](https://www.linkedin.com/company/ucsdcarta)
- [cartaucsd](https://www.youtube.com/channel/UC...)

