

Common Coordinate Framework Meeting

December 11 – 12, 2017

National Institutes of Health
31 Center Drive, Building 31, Conference Room 6C
Bethesda, Maryland, 20892

Agenda

Day 1

(All general sessions will be held in Room 6)

8:00 AM – 8:45 AM **Registration**

8:45 AM – 9:00 AM **Welcome and Opening Remarks**
Richard Conroy (NIH, Office of Strategic Coordination)
Aviv Regev (Broad Institute)
Sarah Teichmann (Sanger Institute)
Jonah Cool (Chan Zuckerberg Initiative)

Session 1: Framing the Framework

9:00 AM **The Anatomy Of The Human Body: what makes us so similar and yet so different**
Rosalyn Jurjus (George Washington University)

9:20 AM **Facts And Myths Of Using Postmortem Tissue For Research**
Christine Iacobuzio-Donahue (MSKCC)

9:50 AM **HDBR: a fetal tissue resource enabling human developmental research**
Susan Lindsay (Newcastle University)

10:10 AM **Round-the-Table Discussion – Scope and starting points for a human body Common Coordinate Framework**

10:30 AM **Break**

Session 2: Using Our Brain

11:00 AM **Brain Common Coordinate Frameworks: extensible principles and new challenges in the single cell analysis era**
Ed Lein (Allen Institute)

11:20 AM	Ontologies, Atlases And Co-Ordinate Systems, From Flies And Mice To Humans David Osumi-Sutherland (EBI)
11:40 AM	TBD
12:00 PM	Round-the-Table Discussion – Developing a common language for all people
12:30 PM	Lunch – Meals and light refreshments are at the expense of attendees. (Attendees will be responsible for meals and/or light refreshments on their own, at their own cost. The government and/or government contractors are not involved in facilitating the provision of food and/or light refreshments).
1:30 – 3:00 PM	Working Group Discussions Group 1: Integrating spatial and omics information over multi-scales – how to streamline and optimize the workflow (Room 6) Lead Discussants: Anne Plant (NIST), Alex Shalek (MIT) Group 2: Building the language of a CCF – collecting the right metadata and integrating ontologies (Room 7) Lead Discussants: Laura Clarke (EBI), Maryann Martone (UCSD) Group 3: Building the computational infrastructure for storing, visualizing, and searching a human body atlas (Room 8) Lead Discussants: Alex Wiltschko (Google), Robert Murphy (CMU)
3:00 PM – 3:15 PM	Break
3:15 PM – 4:45 PM	Sharing Ideas & Group Discussion 1. Working Group 1 2. Working Group 2 3. Working Group 3
4:45 PM – 5:00PM	Wrap-Up - Day 1 Richard Conroy (NIH, Office of Strategic Coordination) Aviv Regev (Broad Institute) Sarah Teichmann (Sanger Institute) Jonah Cool (Chan Zuckerberg Initiative)
5:00 PM – 6:00PM	Demo Session

Day 2

(All general sessions will be held in Room 6)

8:45 AM – 9:00 AM

Framing of the Day

Richard Conroy (NIH, Office of Strategic Coordination)
Aviv Regev (Broad Institute)
Sarah Teichmann (Sanger Institute)
Jonah Cool (Chan Zuckerberg Initiative)

Session 3: Building on Knowledge, Models and Statistics

9:00 AM

Sampling Cells By Organ, By Location And By Individual

John Marioni (EBI)

9:20 AM

Capturing Variation in The Cell Atlas Across Healthy Human Populations

Barbara Engelhardt (Princeton)

9:50 AM

TBD

Partha Mitra (CSHL)

10:10 AM

Round-the-Table Discussion – Assumptions, inferences and registration – intelligent sampling, using sparse data and comparing individuals

10:30 AM

Break

11:00 – 12:30 PM

Working Group Discussions – Building a CCF that is robust and provides insights...

Working Group 4 Across the lifespan **(Room 6)**

Lead Discussants: Marius Linguraru (Children's), Kristin Ardlie (Broad)

Working Group 5 Across inter-individual variation **(Room 7)**

Lead Discussants: Jason Swedlow (Dundee), Alexis Battle (JHU)

Working Group 6 Across the health-disease continuum **(Room 8)**

Lead Discussants: James Gee (UPenn), Zorina Galis (NHLBI)

12:30 PM

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1:30 PM – 3:00 PM

Sharing Ideas & Group Discussion

1. Working Group 4
2. Working Group 5
3. Working Group 6

3:00 – 3:30 PM

Wrap-Up and Adjourn Meeting

Richard Conroy (NIH, Office of Strategic Coordination)
Aviv Regev (Broad Institute)
Sarah Teichmann (Sanger Institute)
Jonah Cool (Chan Zuckerberg Initiative)

ABOUT THE MEETING

This Common Coordinate Framework Workshop is supported by the National Institutes of Health, the Chan Zuckerberg Initiative and the Human Cell Atlas initiative.

MEETING OBJECTIVES

The focus of the meeting will be on constructing a robust reference framework for defining location at multiple scales in the body, how to include lifespan, natural variation and disease phenotypes into this framework, while at the same time making it practical, simple and relevant. The format of the meeting will be a series of discussion topics around different aspects of a common coordinate system, spanning scales from pathology to anatomy, and we'll post a more detailed agenda and description of the discussion topics in the coming weeks. The outcomes from this meeting will help inform the direction for NIH's human atlas programs and the Human Cell Atlas initiative. Please note that we are unable to support travel and accommodation for this meeting.

LOCATION

Conference Room 6C, Building 31
31 Center Drive, Bethesda, Maryland (see [map](#))
[Medical Center Metro Station \(Red Line\)](#)

NIH VISITOR INFORMATION

The NIH campus requires a valid, current, photo ID for entry. Details of campus access and security can be found [here](#). You must present a valid form of ID. Expect the security check to take 20-30 minutes. Visitor passes must be worn at all times. If you leave campus and return at a later time, you will be required to go through security again upon re-entry. Parking on campus is limited and is paid parking. If you are not an NIH employee, you will need to pass through NIH security at the Gateway Center (from Rockville Pike – Route 355) before you are allowed on campus. All vehicles and passengers must be screened at the Gateway Visitor's entrance. Please allow adequate time for security screening. Visit the [NIH visitor's web page](#) for more information.

FOOD & BEVERAGES

Food and beverages must be purchased. A full cafeteria is open from 6:30 a.m. - 2:30 p.m. located on the ground floor of Building 31.

LODGING INFORMATION

Participants are responsible for all lodging charges, taxes, and incidentals.

Summary of CCF Planning Meeting – September 2017

Generating an atlas of any organism or individual organ requires integration of diverse types of data and input from many fields of study. The goal of the December 11-12, 2017 Common Coordinate Framework (CCF) Workshop is to foster discussion and guidance from experts on paths and key challenges that need to be addressed to achieve a CCF for the human body. Location is a critical input to any atlas in terms of both absolute location of a given entity and in terms of context within an abstract map that captures common features across individuals. The key question for this workshop is how we can move forward with on a path towards a CCF and identify outcomes that can iteratively feedback to inform efforts to build toward an increasingly accurate and robust CCF for current and future human atlas efforts.

In September, a small meeting was convened to discuss and plan this larger workshop. The goal was to help frame the discussion of key bottlenecks prior to the larger meeting. The brief summaries below capture the discussion and provide some context for the talks and breakouts planned for the workshop on December 11th and 12th. Thank you to all the participants in this planning meeting!

Learning from the past: The brain community has developed a set of widely-used coordinate frameworks that help to address the brain's architectural and functional complexity and the interrelationship of the two. Initial work on the mouse led to development of shared vocabulary and a common structural map. Coordinate frameworks generated in the mouse are generally incompatible for human. The size of human tissues is significantly greater and increases the challenge of integrating across multiple scale and inputs. Defining the useful resolution of a CCF and how to integrate data types including medical imaging, microscopy, and molecular analysis are challenges for larger human samples.

Building versus learning: Learning from past atlas efforts while looking forward raises key questions: Is it better to methodically build a CCF, learn a CCF as data is generated or some combination of the two?

Building a CCF leverages empirical knowledge and translates decades, if not centuries, of anatomical studies. Several projects have used a gridding approach to construct average representations of organs and it is conceivable that future work could gradually refine the detail of the grid. Using constant anatomical landmarks as anchor points, variation from donor age, sex, and health status could help refine an average representation.

Learning a CCF takes a different approach and would use a variety of inputs to generate a high-dimensional space in which cells or structures are assigned a probabilistic location. A benefit of this approach is that generative models are dynamic and constantly learn from future work while discerning unique and diverse features in a high dimensional space. Challenges often include defining the features of the space, retention of the initial tissue structure, and the extensive data required for a useful CCF. How can we ensure that a CCF is dynamic and "future proof?"

Collection and standard analysis of tissue: Creating a CCF will require collection and analysis of many primary samples. Both built and learned approaches will benefit from standardized collection, photo documentation, and consultation with pathologists. But what are the appropriate pipelines and how are they disseminated and quality controlled? What are the most critical aspects to document and standardize and how can the pathology community be engaged?

Ontologies: A common vocabulary is important to maintain understanding and consistency of any CCF. Ontologies historically rely on morphological features but are beginning to adapt to more complex or dynamic measures. Current ontologies usually describe predefined cells or structures while struggling to handle more dynamic data with poorly described features. Ontologies help anchor new data or findings relative to prior knowledge and may help provide a bridge.

Common Coordinate Framework (CCF) Meeting Background

What is a CCF?

A CCF for the human body reproducibly and uniquely defines any location in a human body.

How are CCFs defined?

CCFs can be defined as a projected coordinate system in cartesian, spherical, or cylindrical space relative to an origin/datum/plane. A single origin point, or a system of origin points could be defined – for example bones or joints can provide origins; vascular branch points; specific cellular neighborhoods in discrete organs; or a system of surface markers – alternatively the 3 planes of the body could be used. The challenges for a human CCF are how to have robust set of origin points that are practical over microns to meters and across the variance of human bodies. The second step of defining projections from these origin points and the relationship between them adds complexity.

Important considerations...

Sampling, registration, inference, transformation, segmentation, terminologies and ontologies...

Are there examples of CCFs / Atlases?

- [Human Anatomy Atlas](#)
- [Allen Mouse Brain Atlas](#)
- [Brainnetome Atlas](#)
- [Scalable Brain Atlas](#)
- [eMouse Atlas](#)
- [Celestial Coordinate Systems](#), [Geographic Coordinate System](#)

Further reading:

- [Workshop on Interoperable atlases of the human brain](#) – human
- [Open Physiology](#) – human tissue units, CCF based on vessels
- [Computational Anatomy](#) – human
- [Allen Mouse Common Coordinate Framework](#) - rat
- [‘Waxholm Space’ spatial reference system](#) – mouse
- [Interactive single cell developmental atlas](#) – worm
- [Lessons learned from Brain Cell Atlas](#) (so far!)