HuBMAP

SOP: Creating Crosswalk Tables for 2 Dimensional Functional Tissue Unit Models

Creating, reviewing, and updating crosswalk tables for FTUs

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Introduction

This SOP describes the procedures used to create, review, and update crosswalk tables of 2 dimensional (2D) functional tissue unit (FTU) models produced for the HuBMAP project. The purpose of the crosswalk table is to map the anatomical structures (AS) and cell types (CT) from the ASCT+B table to 2D illustrations of FTUs found in the human body. This document is designed for authors and users of FTU models and may be accessed by anyone interested in procedures related to the HuBMAP project.

Roles and Responsibilities

The **Crosswalk Table Author** is responsible for creating the FTU model, drafting the crosswalk table, and obtaining reviews from those with a role in the procedures documented by the SOP.

The **Medical Illustrator** draws the FTU and its anatomical structures and cell types.

The **Subject Matter Expert (SME)** is an organ subject matter expert with deep domain knowledge of the FTU who has agreed to serve as the technical reviewer. The SME is responsible for ensuring the anatomical and biological accuracy of the FTU.

The **Principal Investigator (PI)** holds final responsibility for determining the list of anatomical structures represented in each FTU.

Table 1. Roles, names, and email addresses of key personnel.

Role	Name	Email
Crosswalk Table Author	Fauzan Isnaini	faisna@iu.edu
Medical Illustrator	Rachel Bajema	rbajema@iu.edu
Subject Matter Expert (SME)	Depends on the FTU	
Principal Investigator (PI)	Katy Börner	katy@indiana.edu

Procedures

Identifying a functional tissue unit

These procedures outline the process of deciding which FTUs to illustrate and what to call them.

1. The crosswalk table author identifies the names of FTUs to be modeled using current research priorities and then consults the ASCT+B table to get a list of anatomical structures and cell types present in that FTU. The author sends this list of anatomical structures per FTU to the SME for review.
2. The SME then may approve, reject, or suggest changes to the list of anatomical structures per FTUs. For example, they may suggest anatomical structures that are more useful or more representative.
3. The list of proposed FTUs and their AS is then sent to the PI for review.

Identifying the anatomical structures and cell types

1. The crosswalk table author identifies all of the possible anatomical structures and cell types inside the functional tissue unit, using the ASCT+B table and medical literature.
2. The crosswalk table author sends the list of anatomical structures and cell types to the SME for review. If multiple SMEs are working together they come to consensus via email. The list should contain:
    a. the name of the AS/CT
    b. the ontology ID (if available) of the FTU (e.g., UBERON for anatomical structures or Cell Type Ontology for cell types)
    c. whether the proposed AS/CT presents in the ASCT+B table
    d. a list of references used to create the list of anatomical structures and cell types.
3. The SME then may approve, reject, or suggest changes to the list of anatomical structures and cell types.

Illustrating the FTU and creating the crosswalk table

1. The approved list of anatomical structures and cell types is then sent to the medical illustrator for illustration.
2. The medical illustrator creates a 2D image of the FTU and saves the file in the SVG format. Each cell and each anatomical structure should be easily identifiable by their SVG ID (e.g., two red blood cells in an SVG image may be given ID: red_blood_cell_1 and red_blood_cell_2 respectively).
3. The crosswalk table author then reviews the illustration to confirm all anatomical structures and cell types have been represented in the illustration.
4. The author then creates the crosswalk table as a spreadsheet. The crosswalk table should follow this format. The crosswalk table should have one row for each instance of a cell or anatomical structure (e.g., if there are five cells of a cell type in the drawing, the crosswalk table should have five rows to represent the SVG structures).
5. The author then sends the crosswalk table and the FTU illustration to the SME for technical review.
6. The SME then may approve, reject, or suggest changes to the crosswalk table and the drawing. The SME reviews both documents to ensure that there are no missing elements and that elements are shown correctly, e.g. position of the cells.

Publishing the Crosswalk Table

1. The crosswalk table and the illustration are sent to the PI for review.
2. The approved crosswalk table is then published in the Google Sheet.
3. The 2D FTU model is then published on the CCF portal webpage.
4. Progress and final approvals are tracked by the crosswalk author in a document that is available on request.

Updating the Table

The process of updating the table is the same as the process of creating the table. SME review and approval is required.

References and Definitions

References

de Bono, B., Grenon, P., Baldock, R., & Hunter, P. (2013). Functional tissue units and their primary tissue motifs in multi-scale physiology. *Journal of biomedical semantics*, *4*(1), 22. https://doi.org/10.1186/2041-1480-4-22

Börner, K., Teichmann, S.A., Quardokus, E.M. *et al.* Anatomical structures, cell types and biomarkers of the Human Reference Atlas. *Nat Cell Biol* **23,** 1117–1128 (2021). https://doi.org/10.1038/s41556-021-00788-6

Glossary

Principal Investigator (PI): Person who is responsible for the overall conduct of the research at a given site.

ASCT+B: Anatomical Structures, Cell Types and Biomarkers

ASCT+B Tables: Anatomical Structures, Cell Types and Biomarkers (ASCT+B) Tables are authored by multiple experts across many consortia. The tables capture the partonomy of anatomical structures, cell types and major biomarkers (e.g., gene, protein, lipid or metabolic markers).

Functional Tissue Unit (FTU): a functional tissue unit consists of a three-dimensional block of cells centred around a capillary, such that each cell in this block is within diffusion distance from any other cell in the same block.