



# GUDMAP

## Genitourinary Development Molecular Anatomy Project



Other Current Consortium Members: Aronow, B., Cohn, M.J., Hoshizaki, D., Keast, J., Little, M., Mendelsohn, C., Potter, S., & McMahon, A.P.



Reporter Strains - Gene Nominations

The project has generated a resource of

novel transgenic mouse strains carrying

production of reproter strains available at:

Strains were chosen on the basis of in situ

expression analysis and functional studies.

expression results, to facilitate detailed

genetic markers, with charaterisation,

verification and the new strategy for

www.gudmap.org/Resources/

MouseStrains/index.html







### About GUDMAP

www.gudmap.org

The GenitoUrinary Development Molecular Anatomy Project (GUDMAP) is a consortium of laboratories working to provide the scientific and medical community with gene expression data, transgenic mice and tools to facilitate research.

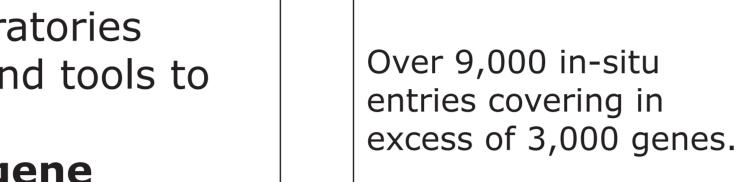
The data provided by GUDMAP include large-scale in-situ hybridisation screens and microarray gene expression data of microdissected, laser-captured and FACS-sorted components of the developing mouse genitourinary (GU) system. These expression data are annotated using a high-resolution ontology specific to the developing murine GU system. GUDMAP data are freely accessible via easy-to-use interfaces. This curated, high-resolution dataset serves as a powerful resource for biologists, clinicians and bioinformaticians interested in the developing urogenital system.

#### Gene Strips

GUDMAP data can be accessed via simple or advanced queries.

A gene query will return 'Gene Strips' - these summaries provide an overview of the expression data available for a

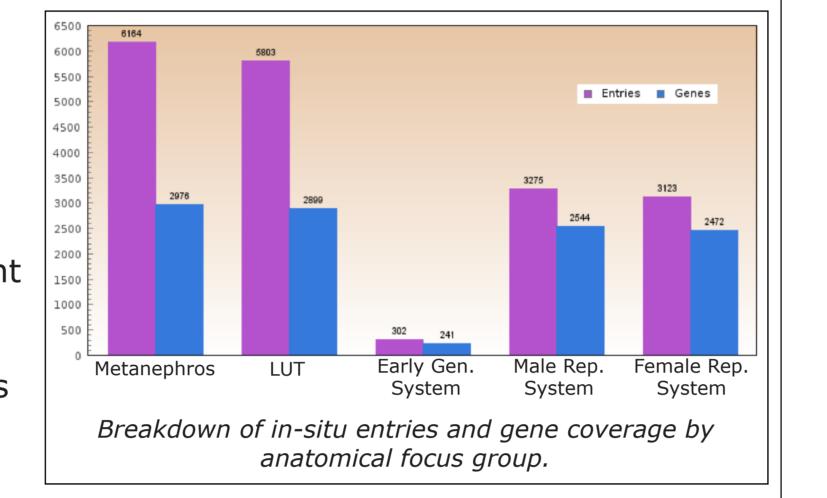
E: (GUDMAP:14088) Wt1 expression in the metanephros (TS23)



2893 unique genes analysed by wholemoun & 760 by section ISH

Database Statistics

395 microarray samples



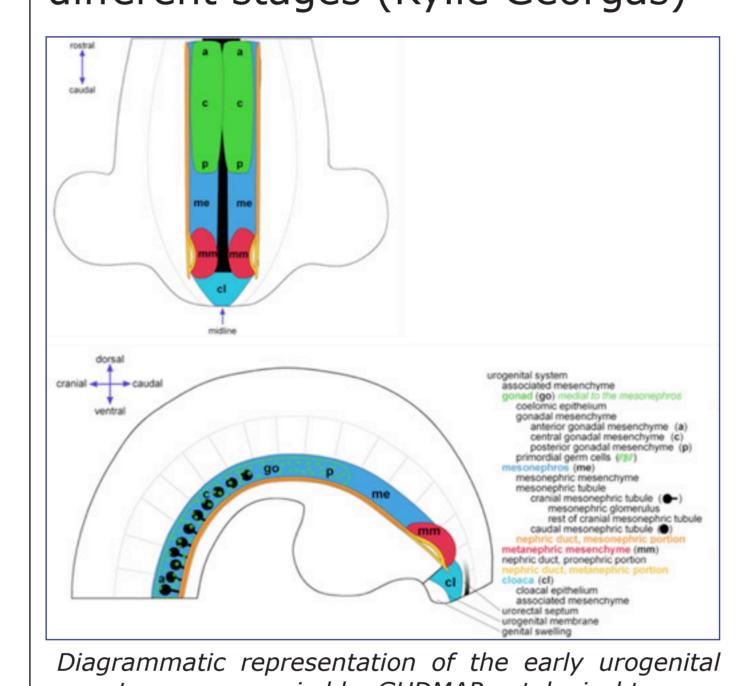
The gene strip links out to in-situ data & images, disease/phenotype associations and microarray expression

Inclusion of RNA-SEQ data and Genesets are part of GUDMAP future

#### Tutorials on GU Development

The website provides **tutorials** describing GU organogenesis (Matt Kaufman)

These are supplemented with schematics diagrams that serve to illustrate the developing components of the mouse GU system over different stages (Kylie Georgas)



medial - lateral

#### structures of the developing kidne Tissue Summaries

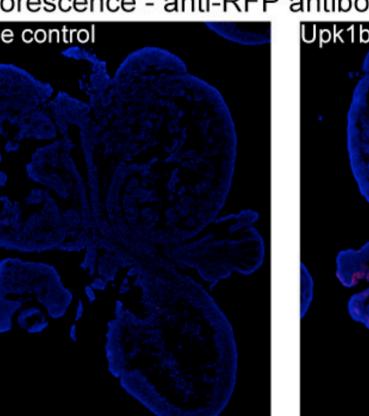
Data relating to a specific tissue of the GU system is summarised in these pages

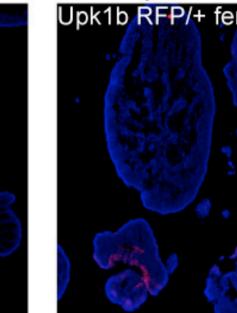
Schematic diagrams, text descriptions and development diagrams (far-right panels) give details about the tissue

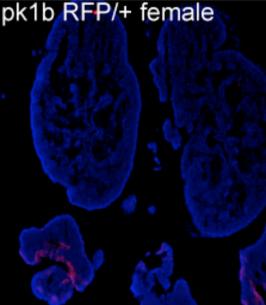
Graphical display of in-situ database entries and number of genes where expression is present in the tissue

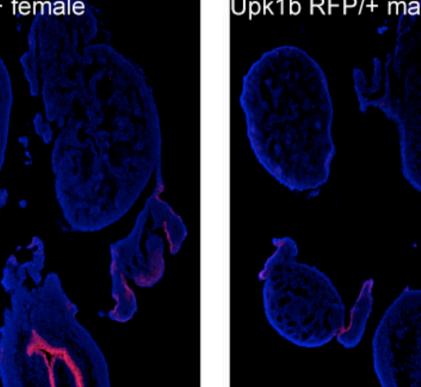
Details of any known anchor or marker genes for the tissue

To be extend to include relevant genelists and microarray samples









www.gudmap.org

Example of GUDMAP strain characterisation. RFP signal is detected in the urothelium of the bladder, as well as the gonads of Upk1bRFP/+ samples

#### GUDMAP will continue to generate novel transgenic mouse strains

Using gene-specific targeting to mark key cell populations of broad interest to the community and to facilitate genetic modification within the cell-of-interest.

Gene nominations for targeting are sought from the research community. Genes expressed throughout the urogenital system will be considered, with a preference towards gene targets expressed in the lower urinary tract. Once generated and verified, mice will be made available to nominating investigators and deposited in a MMRRC (public repository) for broader distribution to the community.

www.gudmap.org/About/News/MS\_GeneNoms.php

#### **GUDMAP Contains:** In-situ hybridization screens (wholemount and section) ew annotated components as a list Show annotation under groups In-situ analysis of transgenic reporter screens Nephrogenic zone & cortex. Wnt4 RNA signal in early nephrons. Note that Calb1 protein (wholemount) Immunohistochemistry (section) Nephrogenic zone. Wnt4 in renal vesicle on left and pretubular aggregate on the right of the Calb1 expressing ureteric tips. Both Wnt4 and Calb1 are absent from the connecting metanephros (EMAP:8226) **LEFT:** Main features of a GUDMAP In-Situ Entry. renal capsule (EMAP:8237) nephrogenic zone (EMAP:27724) A. Images. B. Annotation (user can select list or Nephrogenic zone and cortex. Wnt4 in early nephrons. Note S-shaped body at centre nephrogenic interstitium (EMAP:2773 tree view). C. Probe details. cap mesenchyme (EMAP:27738) pretubular aggregate (EMAP:27745) The **high-resolution anatomy ontology** has renal vesicle (EMAP:27831) been developed by the GUDMAP consortium to comma-shaped body (EMAP:27837) describe in detail the sub-compartments of the pupper limb of comma-shaped body (EMAP:2784? Origin of Clone used to make the Probe: Flower limb of comma-shaped body (EMAP:2784) developing murine genitourinary tract renal connecting segment of comma-shaped body (EMA Type: antisense Labelled with: digoxigenin Visualisation alkaline phosphatase + BM purple s-shaped body (EMAP:27855) **BELOW:** Example images from GUDMAP B: (GUDMAP:11296) Wnt4 RNA expression in the early nephron C: (GUDMAP:11389) Ets1 RNA expression in components of the urogenital sinus and urorectal septum D: (GUDMAP:8200; GUDMAP:8209) Metanephros double-stained for Wt1 protein (orange) and Wnt4 RNA (blue)

#### Microarray Data & **Analysed Genelists** cDNA Microarray data

Above: Heatmap view of analysed microarray genelists. Genes enriched

in the ureteric bud shown against samples from the developing kidney

(www.gudmap.org/gudmap/pages/genelist\_folder.html)

Microarray Expression Profile for: Ureteric Bud (gene list) (View Microarray Analysis He

667 Rows: Page 1 of 34

1441742\_at

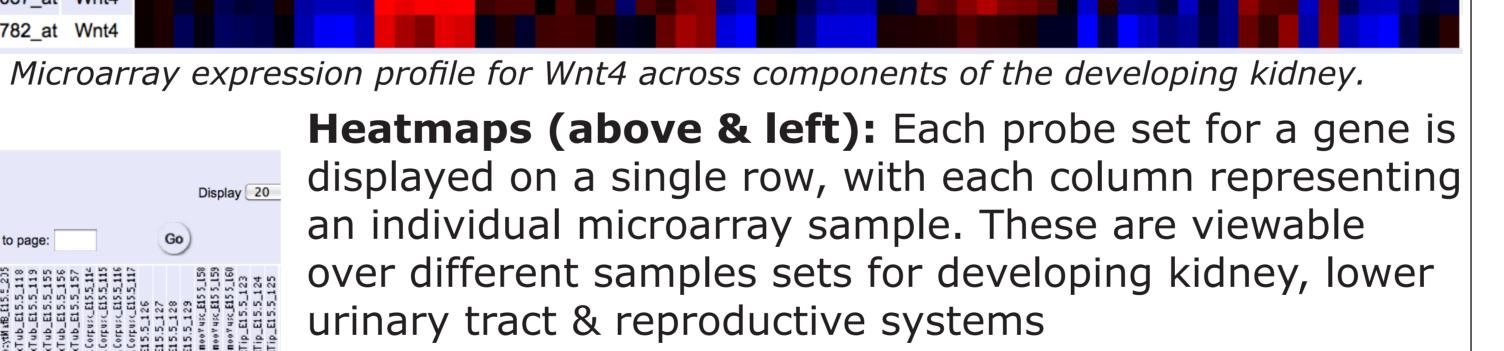
1435438\_at

1455947\_at

1428223\_at

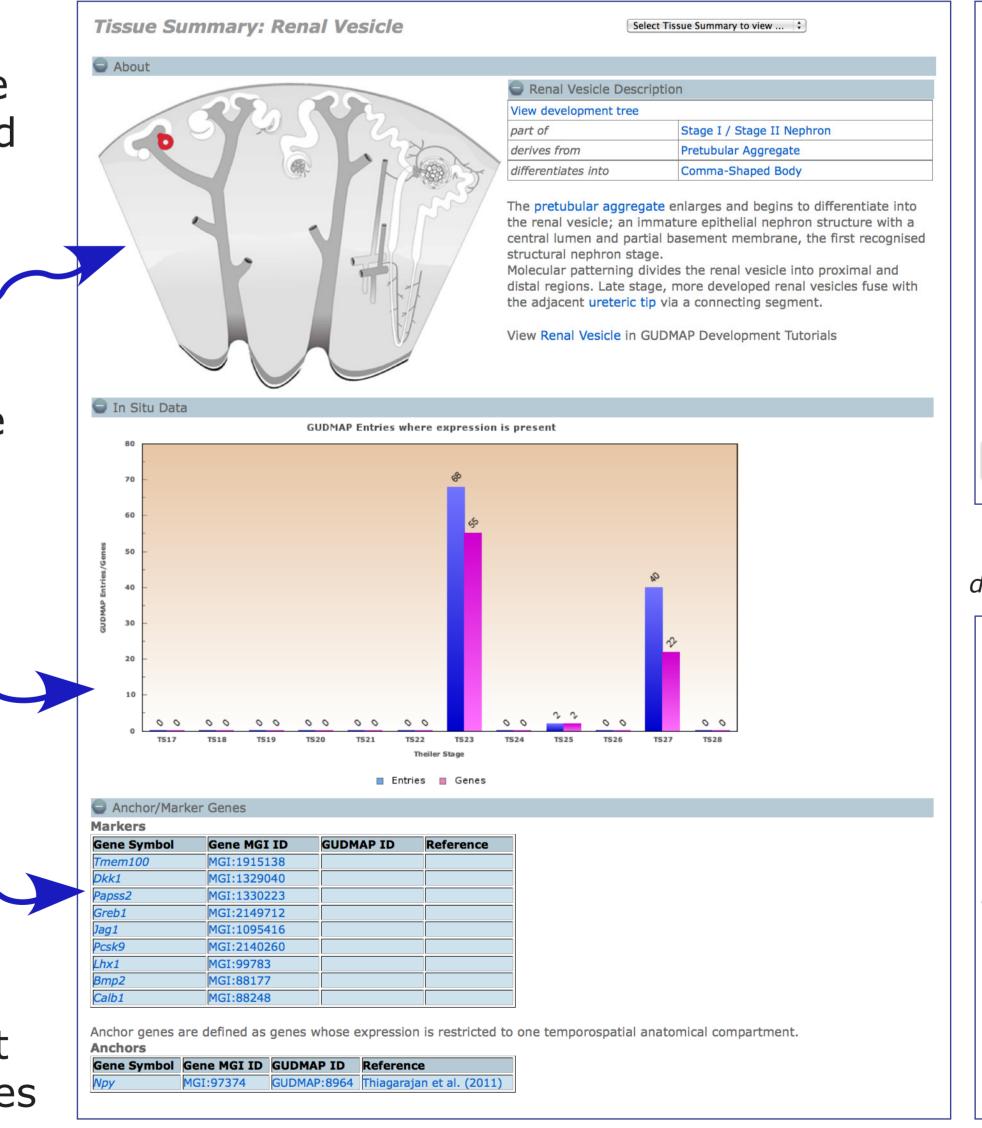
(Brunskill et al., 2008).

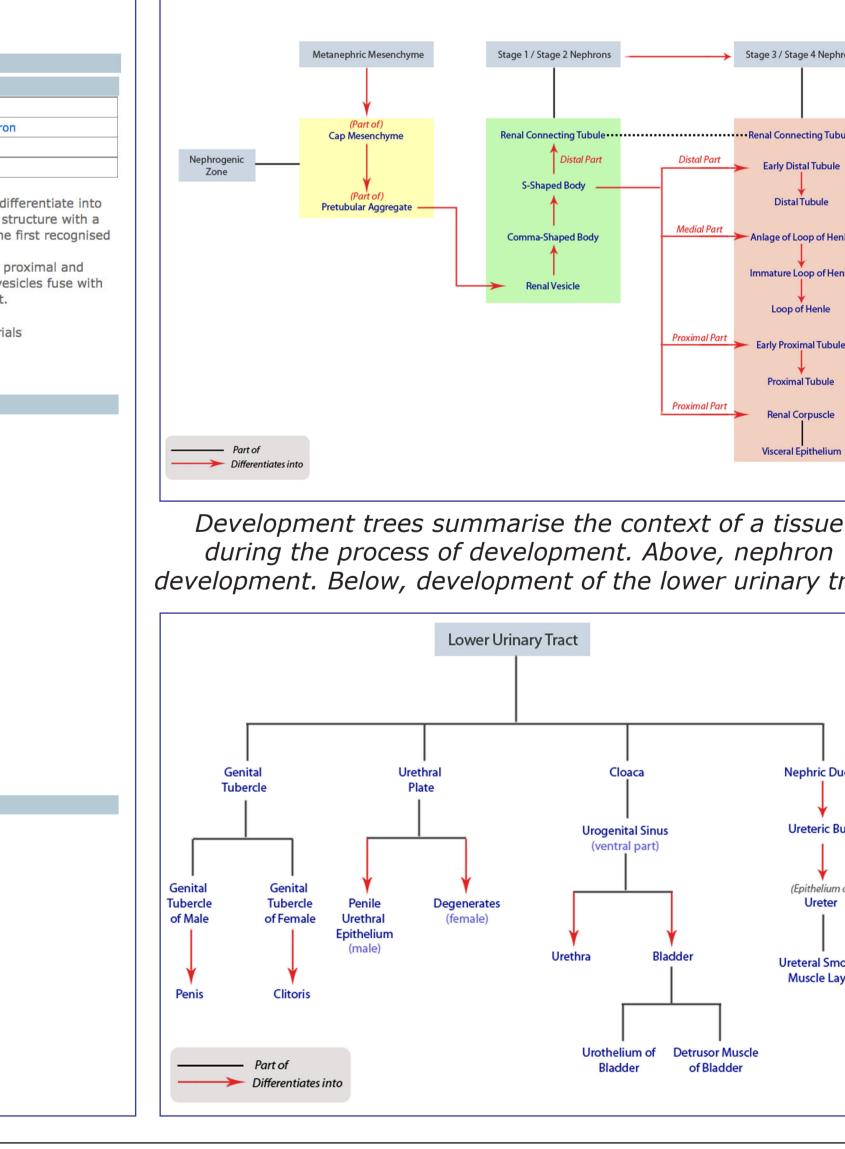
- Array analysis of laser-captured components of the developing GU
- Array analysis of FACS-isolated cells from transgenic reporter mice



Analysis & Genelists (left): Brunskill et al. generated microarray gene expression data for 15 separate subcompartments of the developing kidney. Analysis identified genes enriched in these compartments. These analysed gene lists are available on the GUDMAP

Current work is bringing a much broader analysis of genes to the GUDMAP website. Provision of pre-analysed genelists - covering different sample sets and including clustered gene sets. These can be extended to enable comparison of genelists and the ability to perform onthe-fly analysis via ToppGene and GATACA (http:// gataca.cchmc.org/gataca/gudmap).





#### References

Harding SD et al. (2011). The GUDMAP database - an online resource for genitourinary research. Development. 138(13):2845-53 Brunskill EW et al. (2008). Atlas of gene expression in the developing kidney at microanatomic resolution. Dev. Cell. 15(5):781-91 McMahon AP et al. (2008). GUDMAP: the genitourinary development molecular anatomy project. J. Am. Soc. Nephrology. 19(4):667-71 Little MH et al. (2007). A high-resolution anatomical ontology of the developing murine genitourinary tract. Gene Expr Patterns. 7(6):680-99

#### Funding

This work is supported by NIH via grants: DK092983 (R.A.B.), DK070200 (Dr. Duncan Davidson), DK070136 (M.H.L), DK070181 (A.P.M.) DK070251 (S.P.), DK070219 (Dr. Jim Lessard)