Supplementary Table 1. Summary of examples of potential applications.

Feature	Applications
High differentiation efficiency	1. Scalable production UB progenitors 2. Easy for other labs to adopt and utilize methods 3. Tissue engineering of collecting ducts and/or ureteric tissue
Robust branching morphogenesis	1. Gain mechanistic insights into regulation of human UB branching and patterning 2. Model congenital anomalies of the kidney and urinary tract (CAKUT) a) Monogenic causes b) Teratogens (i.e. ACE inhibitors) 3. Tissue engineering of complex kidney organoids based on UB interactions with metanephric cells
Collecting duct development, cell fate decisions, and cytodifferentiation	1. Understand basic mechanisms of formation of radial polarity (corticomedullary axis) 2. Interrogate process of principal cell maturation 3. Identify signals and pathways involved in PC vs IC fate determination (also Lithium-induced DI)
Functional Principal Cells	1. Interrogation of physiology and homeostasis: a) Cell biology of ion transport b) Mechanisms of hormone regulation c) Develop assays for potassium secretion 2. Disease Modeling: a) Salt sensitivity/primary hypertension b) Monogenic hypertension (e.g. Liddle) c) Electrolyte wasting disorders (pseudohypoaldosteronism) d) Water disequilibrium (Lithium-induced nephrogenic DI) (Congenital nephrogenic DI) 3. Study effect of potential pharmacologic agents on different aspects of principal function 4. Engineering 3D perfusable CD tubules for modeling physiology and for regenerative medicine
Functional Intercalated Cells	1. Basic IC development and physiology a) A-IC vs B-IC determination/polarity b) Mechanisms of acid/base secretion 2. Disease Modeling: a) Distal renal tubular acidosis b) Kidney stone disorders 3. Identify candidate molecules that impact urine acidification or alkalinization.

Supplementary Table 2. QPCR primer sequences

Gene	Forward primer	Reverse primer
AQP2	CACGTCTCCGTTCTCCGAG	CTGTTGCTGAGAGCATTGACA
CDH1	CGAGAGCTACACGTTCACGG	GGGTGTCGAGGGAAAAATAGG
ELF5	TAGGGAACAAGGAATTTTTCGGG	GTACACTAACCTTCGGTCAACC
EMX2	CGGCACTCAGCTACGCTAAC	CAAGTCCGGGTTGGAGTAGAC
EYA1	GTCACAGTCTCAGTCACCTGG	GGGATAAGACGGATAGTCCTGC
FOXF1	CCCAGCATGTGTGACCGAAA	ATCACGCAAGGCTTGATGTCT
GAPDH	CCCATCACCATCTTCCAGGAG	CTTCTCCATGGTGGTGAAGACG
GATA3	GCCCCTCATTAAGCCCAAG	TTGTGGTGGTCTGACAGTTCG
HNF1B	TCAGCTGCTGTTTCTCTTTCCA	GCGGCGCATCTTCTTGTT
HOXA11	TGCCAAGTTGTACTTACTACGTC	GTTGGAGGAGTAGGAGTATGTCA
HOXB7	AACTTCCGGATCTACCCCTG	CTTTCTCCAGCTCCAGGGTC
LHX1	CCTGGACCGCTTTCTCTTGAA	ACCGAAACACCGGAAGAAGTC
MIXL1	GGCGTCAGAGTGGGAAATCC	GGCAGGCAGTTCACATCTACC
NANOG	TGATTTGTGGGCCTGAAGAAA	GAGGCATCTCAGCAGAAGACA
OSR1	CCCATTTCGGTAGTTGCAGT	CCTTCAGCTAAAGCCCCAG
PAX2	TGTCAGCAAAATCCTGGGCAG	GTCGGGTTCTGTCGTTTGTATT
PAX8	AAGTGCAGCAACCATTCAACC	CTGCTCTGTGAGTCAATGCTTA
RET	ACACGGCTGCATGAGAACAA	GCCCTCACGAAGGGATGTG
SCNN1B	AGACAACCACAATGGCTTAACA	TGAGGCTACATAGTCTCATGGC
SCNN1G	GCACCCGGAGAGAAGATCAAA	TACCACCGCATCAGCTCTTTA
SIX2	AAGGCACACTACATCGAGGC	CACGCTGCGACTCTTTTCC
SOX17	GTGGACCGCACGGAATTTG	GGAGATTCACACCGGAGTCA
SOX9	AGCGAACGCACATCAAGAC	CTGTAGGCGATCTGTTGGGG
TBXT	TATGAGCCTCGAATCCACATAGT	CCTCGTTCTGATAAGCAGTCAC
WNT11	GACCTCAAGACCCGATACCTG	TAGACGAGTTCCGAGTCCTTC
WNT7B	GAAGCAGGGCTACTACAACCA	CGGCCTCATTGTTATGCAGGT
WNT9B	TGTGCGGTGACAACCTCAAG	ACAGGAGCCTGATACGCCAT
WT1	GTGACTTCAAGGACTGTGAACG	CGGGAGAACTTTCGCTGACAA

Supplementary Table 3. Primary antibodies

Antigen	Host species	Manufacture	Cat. No.	Dilution
AQP2	Mouse	Santa Cruz	sc-515770	1:200
AQP2	Rabbit	Millipore	178612	1:200
ALDH1A3	Rabbit	Novus	NBP2-15339	1:200
ATP6V1B1	Rabbit	Sigma	HPA031847	1:200
CDH1	Mouse	BD Biosciences	610181	1:500
EMX2	Rabbit	Sigma	HPA065294	1:200
FOXI1	Goat	Abcam	ab20454	1:200
SCNN1B	Rabbit	Gift from L. Palmer		1:100
GATA3	Rabbit	Cell Signaling	D13C9	1:300
HNF1B	Rabbit	Sigma	HPA002083	1:200
GRHL2	Rabbit	Sigma	HPA004820	1:200
HOXB7	Mouse	R&D Systems	MAB8040	1:200
KRT8	Mouse	Santa Cruz	sc-8020	1:100
LHX1	Rabbit	Abcam	ab229474	1:200
Nuclei (hu)	Mouse	Novus	NBP2-34342	1:500
PAX2	Rabbit	BioLegend	PRB-276P	1:200
PAX2	Goat	R&D Systems	AF3364	1:200
PAX8	Rabbit	Abcam	ab189249	1:400
RET	Goat	R&D Systems	AF-1485	1:200
SOX9	Rabbit	Novusbio	NBP1-85551	1:200
SLC26A4	Rabbit	Sigma	HPA042860	1:200
SLC4A1	Rabbit	Sigma	HPA015584	1:200
TBXT	Goat	R&D Systems	AF2085	1:200