

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

I. Specific cell type markers	Time point
ACTA2 alpha-actin-2 syn: a-SMA, alpha-smooth muscle actin *cytoskeletal protein	all
ABCA3 <i>NEW</i> ATP-Binding Cassette, subfamily A ,member 3 (syn: ATP-Binding Cassette Transporter 3; ABC Transporter 3) * a 1,704-amino acid polypeptide with 2 homologous repeats, each harboring 6 putative transmembrane helices and an ATP-binding domain.	E16.5 E18.5 P07, P28
AGER <i>NEW</i> Advanced Glycosylation End Product-specific Receptor syn: RAGE, Receptor for Advanced Glycation End Products *a multi-ligand member of the immunoglobulin superfamily *an integral transmembrane protein /receptor	E16.5 E18.5 P07, P28
CALCA Calcitonin/Calcitonin-related polypeptide, alpha syn: CGRP, calcitonin gene-related peptide *neuropeptide hormone / secretory protein	all
CSPG4 Chondroitin Sulfate Proteoglycan 4 syn: NG2, nerve/glial antigen 2 proteoglycan *integral transmembrane protein	all
EMCN Endomucin (a sialomucin) *integral transmembrane sialomucin	all
HOPX HOP Homeobox syn: HOP, Homeodomain-only protein	E16.5

***nuclear transcription factor**

E18.5

P07, P28

LYVE1	all
Lymphatic vessel endothelial hyaluronan receptor 1	
*type 1 integral transmembrane glycoprotein	
SCGB1A1	E16.5
Secretoglobin, family 1A, member 1	
syn: CCSP, Clara cell secretory protein	
syn: UGB, uteroglobin	E18.5
syn: CC10, Clara-cell specific 10-kD protein	
*secretory protein, binds PC, PI;	
inhibitor of phospholipase A2	P07, P28
SFTPC	E16.5
Surfactant, pulmonary-associated protein C	
syn: SP-C, surfactant protein C	
*hydrophobic peptide associated with surfactant phospholipids, secreted into the alveolar lumen	E18.5
	P07, P28
SOX2	all
SRY (sex determining region Y)-BOX 2	
*nuclear transcription factor	
*nuclear transcription factor	
TUBA1A	E16.5
Tubulin, alpha-1A (acetylated)	
GTPase enzymatic activity	
*cytoskeleton / microtubules / ciliary axoneme	E18.5, P07, P28

II. Multiple cell type markers

ARL13B

all

ADP-ribosylation factor-like protein 13B

***a small GTPase - a hydrolase enzyme**

* binds/hydrolyzes guanosine triphosphate

NKX2-1

E16.5

NK2 Homeobox 1 (homeobox protein)

syn: TTF1, thyroid transcription factor-

syn: TEBP, thyroid-specific enhancer-binding protein

***a nuclear transcription factor**

E18.5

P07, P28

pHisH3

all

*phosphorylated Histone H3

***localized to chromosomes in dividing/mitotic cells**

i.e., in the G2 phase of the cell cycle, during the transition to M phase, and is coincident with mitotic chromosome condensation

*used to calculate mitotic index

SOX9

E16.5

SRY (sex determining region Y)-BOX 9

E18.5

P07, P28

VIM *NEW*

E16.5

Vimentin

*Member of the intermediate filament family

***intracellular, cytoskeletal type III intermediate filament**

*cell marker for non-epithelial, [mesenchyme-derived cells](#) (except for muscle cells that express desmin)

E18.5

P07, P28

Application for Image Detail Box

smooth muscle cell
myofibroblast

N/A

epithelial cell
immature type II pneumocyte

epithelial cell
type II pneumocyte

epithelial cell
immature type I pneumocyte

epithelial cell
immature type I pneumocyte

epithelial cell
type I pneumocyte

epithelial cell
neuroendocrine cell

pericyte

endothelial cell
vascular endothelial cell
venous endothelial cell

epithelial cell
immature type I pneumocyte
Intermediate pneumocyte

epithelial cell
immature type I pneumocyte
Intermediate pneumocyte

epithelial cell
type I pneumocyte

endothelial cell
lymphatic endothelial cell
venous endothelial cell

epithelial cell
immature club cell

epithelial cell
immature club cell

epithelial cell
club cell

epithelial cell
immature type II pneumocyte,
Intermediate pneumocyte

epithelial cell
immature type II pneumocyte
Intermediate pneumocyte

epithelial cell
type II pneumocyte

tracheal epithelial cell
bronchial epithelial cell
bronchiolar epithelial cell

ciliated cell
nerve fiber

ciliated cell
nerve fiber

epithelial cell
interstitial cell
mesothelial cell
smooth muscle cell

epithelial cell
bronchiolar epithelial cell
pre-alveolar epithelial cell
immature type I pneumocyte
immature type II pneumocyte
Intermediate pneumocyte

epithelial cell
bronchiolar epithelial cell
pre-alveolar epithelial cell
immature type I pneumocyte
immature type II pneumocyte
Intermediate pneumocyte

epithelial cell
bronchiolar epithelial cell
alveolar epithelial cell
type I pneumocyte
type II pneumocyte

proliferative cell

chondrocyte

fibroblast, unclassified

epithelial cell

pre-alveolar epithelial cell

type II pneumocyte

chondrocyte

fibroblast, unclassified

epithelial cell

pre-alveolar epithelial cell

type II pneumocyte

chondrocyte

fibroblast, unclassified

epithelial cell

alveolar epithelial cell

type II pneumocyte

interstitial cell

endothelial cell

pericyte

interstitial cell

endothelial cell

pericyte

fibroblast, unclassified

alveolar macrophage

interstitial cell

fibroblast, unclassified

alveolar macrophage

Cell type (s)

smooth muscle cell

(conducting airways; trachea, bronchi, bronchioles)
(pulmonary blood vessels)

myofibroblast

(pre-alveolar and alveolar parenchyma)

protein not detected / no protein expression

Type II pneumocyte, immature

(pre-alveolar epithelia: transitory duct & terminal saccular epithelia)

Type II pneumocyte

(alveolar epithelia: alveolar duct & alveolus)

Proximal acinar epithelial cell

Type I pneumocyte, immature

(pre-alveolar epithelia: proximal acinar tubule)

Type I pneumocyte, immature

(pre-alveolar epithelia: transitory duct & terminal saccular epithelia)

Type I pneumocyte

(alveolar epithelia: alveolar duct & alveolus)

neuroendocrine cell

(tracheal, bronchial, & bronchiolar epithelia)

pericyte

(subendothelial connective tissue)

endothelial cell

(endothelia of arterioles, capillaries, veins)

bronchiolar epithelial cell, unclassified

proximal acinar epithelial cell

type I pneumocyte, immature (> intermediate pneumocyte)

Intermediate pneumocyte (*SFTPC+*, *HOPX+*)
(distal bronchiolar & pre-alveolar epithelia: proximal acinar tubule epithelia)

type I pneumocyte, immature (*> intermediate pneumocyte*)
intermediate pneumocyte (*SFTPC+*, *HOPX+*) *RARE*
(pre-alveolar epithelia: transitory duct & proximal terminal saccule)

type I pneumocyte
(alveolar epithelia; alveolar duct & alveolus)
endothelial cell
(endothelia of blood & lymphatic vessels)

Club cell, immature
(conducting airway epithelia)

Club cell, immature
(conducting airway epithelia)

Club cell, mature
(conducting airway epithelia)

type II pneumocyte, immature (*>intermediate pneumocyte*)
Intermediate pneumocyte (*HOPX+*, *SFTPC+*)
(pre-alveolar epithelia: distal acinar tubule epithelia)

type II pneumocyte, immature (*> intermediate pneumocyte*)
Intermediate pneumocyte (*SFTPC+*, *HOPX+*) *RARE*
(pre-alveolar epithelia: transitory duct & terminal saccule)

type II pneumocyte
(alveolar epithelia: alveolar duct and alveolus)
tracheal, bronchial, & bronchiolar epithelial cells (subsets)
(conducting airway epithelia)

ciliated cell (*sparse*)
nerve fiber
(conducting airway epithelia)

ciliated cell (*sparse*)
nerve fiber

(conducting airway epithelia)

multiple cell types

bronchiolar epithelial cell

acinar tubule epithelial cell

type I pneumocyte, immature (*HOPX* +)

type II pneumocyte, immature (*SFTPC* +)

Intermediate pneumocyte (*SFTPC*+, *HOPX*+) **(bronchiolar & pre-alveolar epithelia / acinar tubule epithelia)**

bronchiolar epithelial cell

ciliated cell

Club cell

terminal sacculle epithelial cell

type I pneumocyte, immature (*HOPX* +)

type II pneumocyte, immature (*SFTPC* +)

Intermediate pneumocyte (*SFTPC*+, *HOPX*+) **(bronchiolar & pre-alveolar epithelia / transitory duct & terminal sacculle)**

bronchiolar epithelial cell

ciliated cell

Club cell

alveolar epithelial cell

type I pneumocyte (*HOPX* +)

type II pneumocyte (*SFTPC* +)

(bronchiolar & alveolar epithelia / alveolar duct & alveolus)

multiple cell types in all tissue compartments

(see tab)

fibroblast, unclassified (peribronchiolar connective tissue)

distal acinar tubule/bud epithelial cell (pre-alveolar parenchyma)

type II pneumocyte, immature (*SOX9+, SFTPC+ cells, abundant*)

chondrocyte (cartilage: trachea & bronchi)

fibroblast, unclassified (peribronchiolar connective tissue)

terminal sacculle epithelial cell (pre-alveolar parenchyma)

type II pneumocyte, immature (*SOX9+, SFTPC+ cells, sparse*)

fibroblast, unclassified (peribronchiolar connective tissue)

type II pneumocyte (*SOX9+, SFTPC+, very rare*)

(alveolar parenchyma)

endothelial cell (*endothelia of all vessels*)

pericyte (*subendothelial connective tissue*)

alveolar macrophage (*lumen of terminal sacculle*)

endothelial cell (*endothelia of all vessels*)

fibroblast, unclassified (*pre-alveolar parenchyma; interstitial tissue*)

pericyte (*subendothelial connective tissue*)

alveolar macrophage (*lumen of alveolus*)

fibroblast, unclassified (*alveolar parenchyma; interstitial tissue; blood vessel wall*)

Subcellular localization

cytoskeleton / microfilaments

04_18_16

Plasma membrane / *basal* epithelial cell membrane

Plasma membrane / *apical* epithelial cell membrane

Plasma membrane / *apical* epithelial cell membrane

secretory granules

plasma membrane / cell surface

plasma membrane / cell surface

cytoplasm

04_13_16

04_13_16

04_18_16

nucleus

04_13_16

cytoplasm

04_13_16

nucleus

cytoplasm

plasma membrane / cell surface

4_19_16

cytoplasm / secretory pathway

secretory granules

4_19_16

secretory granules

4_19_16

multivesicular bodies

04_13_16

immature / forming lamellar bodies

04_13_16

4_19_16

multivesicular bodies

04_13_16

immature / forming lamellar bodies

04_13_16

lamellar bodies

4_19_16

multivesicular bodies

lamellar bodies

nucleus

04_13_16

cilia /ciliary axoneme

Microtubules

cilia /ciliary axoneme

microtubules

4_19_16

primary cilium
motile cilia

nucleus

4_19_16

4_19_16

nucleus

04_13_16

4_19_16

4_19_16

4_19_16

nucleus

04_13_16

04_13_16

04_13_16

chromatin
chromosome
nucleosome
nucleus

nucleus

4_19_16

nucleus

4_19_16

nucleus

cytoplasm / intermediate filament

cytoplasm / intermediate filament

cytoplasm / intermediate filament

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

Probe

Age

ACTA2

E16.5

alpha-actin-2

(syn: a-SMA, alpha-smooth muscle actin)

***intracellular, cytoskeletal, microfilament protein**

***cell marker for smooth muscle cells & myofibroblasts**

E18.5

P7

P28

**Mouse Embryonic Development
Theiler Stages (TS)**

Lung Developmental Stage

TS24

late pseudoglandular

TS26

early saccular

TS28	alveolar
------	----------

TS28	mature alveoli
------	----------------

Term	Level	
Bronchus	Anatomic structure	adjacent_to
Bronchiole	Anatomic structure	adjacent_to
Proximal bronchiole	Anatomic structure	adjacent_to
Distal bronchiole	Anatomic structure	adjacent_to
Terminal bronchiole	Anatomic structure	adjacent_to
Pre-alveolar parenchyma	Anatomic structure	part_of
Proximal acinar tubule	Anatomic structure	adjacent_to
Pulmonary artery	Anatomic structure	part_of
Pulmonary vein	Anatomic structure	part_of
Pulmonary muscular arteriole	Anatomic structure	part_of
Bronchial smooth muscle	Tissue compartment	part_of
Bronchiolar smooth muscle	Tissue compartment	part_of
Arterial smooth muscle	Tissue compartment	part_of
Venous smooth muscle	Tissue compartment	part_of
Vascular smooth muscle	Tissue compartment	part_of
Interstitial tissue / mesenchyme	Tissue compartment	part_of
Myofibroblast	Cell type	
Smooth muscle cell	Cell type	
Cytoskeleton / microfilaments	Subcellular organelle or structure	

Bronchus	Anatomic structure	adjacent_to
Bronchiole	Anatomic structure	adjacent_to
Proximal bronchiole	Anatomic structure	adjacent_to
Distal bronchiole	Anatomic structure	adjacent_to
Terminal bronchiole	Anatomic structure	adjacent_to
Pulmonary artery	Anatomic structure	part_of
Pulmonary vein	Anatomic structure	part_of
Pulmonary muscular arteriole	Anatomic structure	part_of
Pre-alveolar parenchyma	Anatomic structure	part_of
Interstitial tissue / mesenchyme	Tissue compartment	part_of
Bronchial smooth muscle	Tissue compartment	part_of
Bronchiolar smooth muscle	Tissue compartment	part_of
Arterial smooth muscle	Tissue compartment	part_of

Venous smooth muscle
Vascular smooth muscle
Smooth muscle cell
Myofibroblast
Cytoskeleton / microfilaments

Tissue compartment
Tissue compartment
Cell type
Cell type
Subcellular organelle or structure

part_of
part_of

Bronchiole
Proximal bronchiole
Distal bronchiole
Terminal bronchiole
Pulmonary artery
Pulmonary vein
Pulmonary muscular arteriole
Alveolar parenchyma
Alveolar duct wall
Alveolar septal crest
Primary alveolar septum
Secondary alveolar septum
Alveolar interstitial tissue
Bronchial smooth muscle
Bronchiolar smooth muscle
Arterial smooth muscle
Venous smooth muscle
Vascular smooth muscle
Smooth muscle cell
Myofibroblast
Cytoskeleton / microfilaments

Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Tissue compartment
Tissue compartment
Tissue compartment
Tissue compartment
Tissue compartment
Tissue compartment
Cell type
Cell type
Subcellular organelle or structure

adjacent_to
adjacent_to
adjacent_to
adjacent_to
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of

Bronchiole
Proximal bronchiole
Distal bronchiole
Terminal bronchiole
Pulmonary artery
Pulmonary vein
Pulmonary muscular arteriole
Alveolar parenchyma

Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure
Anatomic structure

adjacent_to
adjacent_to
adjacent_to
adjacent_to
part_of
part_of
part_of
part_of

Alveolar duct wall	Anatomic structure	part_of
Alveolar septum	Anatomic structure	part_of
Alveolar interstitial tissue	Tissue compartment	part_of
Bronchal smooth muscle	Tissue compartment	part_of
Bronchiolar smooth muscle	Tissue compartment	part_of
Arterial smooth muscle	Tissue compartment	part_of
Venous smooth muscle	Tissue compartment	part_of
Vascular smooth muscle	Tissue compartment	part_of
Smooth muscle cell	Cell type	
Myofibroblast	Cell type	
Cytoskeleton / microfilaments	Subcellular organelle or structure	

04_18_16

04_18_16

04_18_16

Mouse Lung - Immunofluorescence staining patterns

Images on LungGENS

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
ARL13B ADP-ribosylation factor-like protein 13B *a small GTPase (a hydrolase enzyme that binds/hydrolyzes guanosine triphosphate) * not a cell marker per se * localized to primary and motile cilia * found in multiple cell types	E16.5	TS24
Note: pleura not visible	E18.5	TS26

Note: not enough high magnification images P7
available in data set to complete analysis of
large pulmonary vessels or pleura

TS28

Note: not enough high magnification images P28
available in data set to complete analysis
large pulmonary vessels or pleura

TS28
mature alveoli

Lung Developmental Stage	Term	Level
late pseudoglandular	Bronchiole	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Pre-alveolar parenchyma	Anatomic structure
	Acinar tubule	Anatomic structure
	Proximal acinar tubule	Anatomic structure
	Distal acinar tubule / bud	Anatomic structure
	Pulmonary artery	Anatomic structure
	Pulmonary vein	Anatomic structure
	Pleura	Anatomic structure
	Acinar tubule epithelium	Tissue compartment
	Bronchiolar epithelium	Tissue compartment
	Bronchiolar smooth muscle	Tissue compartment
	Arterial smooth muscle	Tissue compartment
	Venous smooth muscle	Tissue compartment
	Interstitial tissue / mesenchyme	Tissue compartment
	Acinar epithelial cell	Cell type
	Bronchiolar epithelial cell	Cell type
	Ciliated cell	Cell type
	Fibroblast, unclassified	Cell type
	Interstitial / stromal cell	Cell type
	Mesothelial cell	Cell type
	Smooth muscle cell	Cell type
	Primary cilium	Subcellular organelle or structure
	Motile cilia	Subcellular organelle or structure
early saccular	Bronchiole	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Pre-alveolar parenchyma	Anatomic structure

Transitory duct	Anatomic structure
Terminal sacculle	Anatomic structure
Bronchiolar epithelium	Tissue compartment
Peribronchiolar connective tissue	Tissue compartment
Periarterial connective tissue	Tissue compartment
Interstitial tissue / mesenchyme	Tissue compartment
Bronchiolar epithelial cell	Cell type
Ciliated cell	Cell type
Fibroblast, unclassified	Cell type
Interstitial /stromal cell	Cell type
Smooth muscle cell	Cell type
Primary cilium	Subcellular organelle or structure
Motile cilia	Subcellular organelle or structure

alveolar

Bronchiole	Anatomic structure
Proximal bronchiole	Anatomic structure
Distal bronchiole	Anatomic structure
Terminal bronchiole	Anatomic structure
Alveolar parenchyma	Anatomic structure
Alveolar septal crest	Anatomic structure
Primary alveolar septum	Anatomic structure
Secondary alveolar septum	Anatomic structure
Bronchiolar epithelium	Tissue compartment
Interstitial tissue / mesenchyme	Tissue compartment
Bronchiolar epithelial cell	Cell type
Ciliated cell	Cell type
Fibroblast, unclassified	Cell type
Interstitial / stromal cell	Cell type
Primary cilium	Subcellular organelle or structure
Motile cilia	Subcellular organelle or structure

Bronchiole	Anatomic structure
Proximal bronchiole	Anatomic structure
Distal bronchiole	Anatomic structure
Terminal bronchiole	Anatomic structure
Alveolar parenchyma	Anatomic structure
Alveolar septum	Anatomic structure
Bronchiolar epithelium	Tissue compartment
Intertstitial tissue /mesenchyme	Tissue compartment
Ciliated cell	Cell type

Fibroblast, unclassified
Interstitial / stromal cell
Primary cilium
Motile cilia

Cell type
Cell type
Subcellular organelle or structure
Subcellular organelle or structure

04_18_16

part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of

part_of
part_of
part_of
part_of
part_of

part_of
part_of
part_of
part_of
part_of
part_of

part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of
part_of

part_of
part_of
part_of
part_of
part_of
part_of
part_of

Mouse Lung - Immunofluorescence staining patterns

Images on LungGENS

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
CALCA (Calcitonin/Calcitonin-related polypeptide, alpha) (syn: CGRP, calcitonin gene-related peptide) * neuropeptide hormone / secretory protein *localized to secretory granules *cell marker for neuroendocrine cells	E16.5	TS24
	E18.5	TS26
	P7	TS28
	P28	TS28

Lung Developmental Stage	Term	Level
late pseudoglandular	Bronchiole (<i>rare / sparse</i>)	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Bronchiolar epithelium	Tissue compartment
	Neuroendocrine cell	Cell type
	Secretory granule	Subcellular organelle or structure
early saccular	Bronchiole	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Bronchiolar epithelium	Tissue compartment
	Neuroepithelial body	Tissue compartment
	Neuroendocrine cell	Cell type
alveolar	Secretory granule	Subcellular organelle or structure
	Bronchiole	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Bronchiolar epithelium	Tissue compartment
	Neuroepithelial body	Tissue compartment
mature alveoli	Neuroendocrine cell	Cell type
	Secretory granule	Subcellular organelle or structure
	Bronchiole	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Bronchiolar epithelium	Tissue compartment
	Neuroepithelial body	Tissue compartment
	Neuroendocrine cell	Cell type
	Secretory granule	Subcellular organelle or structure
	Bronchiole	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Bronchiolar epithelium	Tissue compartment
	Neuroepithelial body	Tissue compartment
	Neuroendocrine cell	Cell type
	Secretory granule	Subcellular organelle or structure
	Bronchiole	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Bronchiolar epithelium	Tissue compartment
	Neuroepithelial body	Tissue compartment
	Neuroendocrine cell	Cell type
	Secretory granule	Subcellular organelle or structure
	Bronchiole	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Bronchiolar epithelium	Tissue compartment
	Neuroepithelial body	Tissue compartment
	Neuroendocrine cell	Cell type
	Secretory granule	Subcellular organelle or structure
	Bronchiole	Anatomic structure
	Proximal bronchiole	Anatomic structure
	Distal bronchiole	Anatomic structure
	Terminal bronchiole	Anatomic structure
	Bronchiolar epithelium	Tissue compartment
	Neuroepithelial body	Tissue compartment
	Neuroendocrine cell	Cell type
	Secretory granule	Subcellular organelle or structure

04_18_16

part_of 04_18_16
part_of
part_of
part_of
part_of

part_of
part_of
part_of
part_of
part_of
part_of

part_of
part_of
part_of
part_of
part_of
part_of

part_of
part_of
part_of
part_of
part_of
part_of

Mouse Lung - Immunofluorescence staining patterns

Images on LungGENS

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
CSPG4 Chondroitin Sulfate Proteoglycan 4 (syn: NG2, nerve/glial antigen 2 proteoglycan) *integral transmembrane protein * localised to cell surface / plasma membrane * cell marker for pericytes	E16.5	TS24
Note: not enough high magnification images available in data set to complete analysis of large pulmonary vessels or pleura		
Note: not enough high magnification images available in data set to complete analysis of large pulmonary vessels or pleura	E18.5	TS26
Note: not enough high magnification images available in data set to complete analysis of large pulmonary vessels or pleura	P7	TS28

Note: not enough high magnification images P28
available in data set to complete analysis of
large pulmonary vessels or pleura

TS28

Lung Developmental Stage	Term
--------------------------	------

late pseudoglandular	<ul style="list-style-type: none">Pulmonary arteryPre-alveolar parenchymaPre-alveolar acinar capillary bedIntra-parenchymal blood vesselPulmonary arteriolePulmonary venuleInterstitial tissue / mesenchymeSubendothelial connective tissuePericytePlasma membrane /cell surface
----------------------	---

early saccular	<ul style="list-style-type: none">Pulmonary arteryPre-alveolar parenchymaPre-alveolar saccular capillary bedIntra-parenchymal blood vesselPulmonary arteriolePulmonary venuleInterstitial tissue / mesenchymeSubendothelial connective tissuePericytePlasma membrane /cell surface
----------------	---

alveolar	<ul style="list-style-type: none">Pulmonary arteryPulmonary veinAlveolar parenchymaIntra-parenchymal blood vesselPulmonary arteriolePulmonary venuleAlveolar capillary bedPrimary alveolar septumSecondary alveolar septumAlveolar septal crest
----------	--

Interstitial tissue / mesenchyme
Subendothelial connective tissue
Pericyte
Plasma membrane /cell surface

mature alveoli

Pulmonary artery
Alveolar parenchyma
Intra-parenchymal blood vessel
Pulmonary arteriole
Pulmonary venule
Alveolar capillary bed
Alveolar septum
Interstitial tissue / mesenchyme
Subendothelial connective tissue
Pericyte
Plasma membrane /cell surface

Level

04_18_16

Anatomic structure	adjacent_to	
Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	04_18_16
Anatomic structure	adjacent_to	04_18_16
Anatomic structure	adjacent_to	
Anatomic structure	adjacent_to	
Tissue compartment	part_of	
Tissue compartment	part_of	
Cell type		
Subcellular organelle or structure		

Anatomic structure	adjacent_to	
Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	04_18_16
Anatomic structure	adjacent_to	04_18_16
Anatomic structure	adjacent_to	
Anatomic structure	adjacent_to	
Tissue compartment	part_of	
Tissue compartment	part_of	
Cell type		
Subcellular organelle or structure		

Anatomic structure	adjacent_to	
Anatomic structure	adjacent_to	
Anatomic structure	part_of	
Anatomic structure	adjacent_to	04_18_16
Anatomic structure	adjacent_to	
Anatomic structure	adjacent_to	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	

Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	

Anatomic structure	adjacent_to
Anatomic structure	part_of
Anatomic structure	adjacent_to 04_18_16
Anatomic structure	adjacent_to
Anatomic structure	adjacent_to
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
EMCN Endomucin (a sialomucin) *an integral transmembrane sialomucin * localized to the cell surface / plasma membrane *cell marker for endothelial cells	E16.5	TS24
	E18.5	TS26
	P7	TS28

P28

TS28

Lung Developmental Stage	Term
late pseudoglandular	Pre-alveolar parenchyma Intra-parenchymal blood vessel Pre-alveolar acinar capillary bed Pulmonary arteriole Pulmonary vein Interstitial tissue / mesenchyme Arteriole endothelium Capillary endothelium Venous endothelium Endothelial cell Plasma membrane / cell surface
early saccular	Pre-alveolar parenchyma Intra-parenchymal blood vessel Pre-alveolar saccule capillary bed Pulmonary arteriole Pulmonary vein Interstitial tissue / mesenchyme Arteriole endothelium Capillary endothelium Venous endothelium Endothelial cell Plasma membrane / cell surface
alveolar	Alveolar parenchyma Primary alveolar septum Secondary alveolar septum Alveolar septal crest Alveolar capillary bed Pulmonary vein Interstitial tissue / mesenchyme Venous endothelium Capillary endothelium Endothelial cell

Plasma membrane / cell surface

mature alveoli

Alveolar parenchyma

Alveolar septum

Alveolar capillary bed

Pulmonary vein

Venous endothelium

Capillary endothelium

Endothelial cell

Plasma membrane / cell surface

Level		04_18_16
-------	--	----------

Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	04_18_16

Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	

Cell type

Subcellular organelle or structure

Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	04_18_16

Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	

Cell type

Subcellular organelle or structure

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	

Cell type

Subcellular organelle or structure

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of

Cell type

Subcellular organelle or structure

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
HOPX HOP Homeobox (syn: HOP, Homeodomain-only protein) *a nuclear transcription factor *localized to both cytoplasm and nucleus * a cell marker for type I pneumocytes *at E16.5 localized to: 1) terminal bronchiolar epithelial cells; 2) proximal acinar epithelial cells; 3) immature type I pneumocyte; 4) intermediate pneumocyte Note: proximal-to-distal gradient of decreasing expression levels at E16.5	E16.5	TS24
	E18.5	TS26
	P7	TS28

P28

TS28

Lung Developmental Stage	Term
--------------------------	------

late pseudoglandular	<p>Pre-alveolar parenchyma</p> <p>Terminal bronchiole</p> <p>Proximal acinar tubule</p> <p>Terminal bronchiolar epithelium</p> <p>Proximal acinar tubule epithelium</p> <p>Bronchiolar epithelial cell, unclassified</p> <p>Proximal acinar epithelial cell</p> <p>Type I pneumocyte, immature (> intermediate pneumocyte)</p> <p>Intermediate pneumocyte (SFTPC+, HOPX+)</p> <p>Cytoplasm</p>
----------------------	---

early saccular	<p>Pre-alveolar parenchyma</p> <p>Proximal terminal sacculle</p> <p>Terminal sacculle</p> <p>Transitory duct</p> <p>Terminal sacculle epithelium</p> <p>Transitory duct epithelium</p> <p>Type I pneumocyte, immature (> intermediate pneumocyte)</p> <p>Intermediate pneumocyte (SFTPC+, HOPX+) RARE</p> <p>Nucleus</p> <p>Cytoplasm</p>
----------------	--

alveolar	<p>Alveolar parenchyma</p> <p>Alveolar duct</p> <p>Alveolus</p> <p>Alveolar epithelium</p> <p>Type I pneumocyte</p>
----------	---

Nucleus
Cytoplasm

mature alveoli

Alveolar parenchyma
Alveolar duct
Alveolus
Alveolar epithelium
Type I pneumocyte
Nucleus
Cytoplasm

Level		04_18_16
-------	--	----------

Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Cell type		
Cell type		
Cell type		04_13_16
Cell type		04_13_16
Subcellular organelle or structure		

Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Cell type		04_13_16
Cell type		04_13_16
Subcellular organelle or structure		
Subcellular organelle or structure		

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Cell type		

Subcellular organelle or structure
Subcellular organelle or structure

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	
Subcellular organelle or structure	

Mouse Lung - Immunofluorescence staining patterns

Images on LungGENS

Probe

Age

LYVE1

E16.5

Lymphatic vessel endothelial hyaluronan receptor 1

*a type 1 integral transmembrane glycoprotein

***localized to cell surface**

*** cell marker for endothelial cells**

E18.5

P7

Mouse Embryonic Development Theiler Stages (TS)	Lung Developmental Stage	Term
TS24	late pseudoglandular	Lymphatic vessel Peribronchiolar lymphatic vessel Periarterial lymphatic vessel Pulmonary vein Pre-alveolar parenchyma Pulmonary acinar capillary bed Perivascular connective tissue Peribronchiolar connective tissue Lymphatic endothelium Venous endothelium Capillary endothelium Endothelial cell Cell membrane / cell surface
TS26	early saccular	Lymphatic vessel Peribronchiolar lymphatic vessel Periarterial lymphatic vessel Pulmonary vein Perivascular connective tissue Peribronchiolar connective tissue Lymphatic endothelium Venous endothelium Endothelial cell Cell membrane / cell surface
TS28	alveolar	Lymphatic vessel Peribronchiolar lymphatic vessel

Periarterial lymphatic vessel
Pulmonary vein
Perivascular connective tissue
Peribronchiolar connective tissue
Lymphatic endothelium
Venous endothelium
Endothelial cell
Cell membrane / cell surface

TS28

mature alveoli

Pulmonary artery
Pulmonary vein
Lymphatic vessel
Peribronchiolar lymphatic vessel
Periarterial lymphatic vessel
Alveolar parenchyma
Perivascular connective tissue
Peribronchiolar connective tissue
Arterial endothelium
Lymphatic endothelium
Venous endothelium
Endothelial cell
Cell membrane / cell surface

Level

04_18_16

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Tissue compartment	LYVE1	
Tissue compartment	part_of	
Tissue compartment	part_of	
Cell type		
Subcellular organelle or structure		

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Cell type		
Subcellular organelle or structure		

Anatomic structure	part_of	
Anatomic structure	part_of	

Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
NKX2-1 NK2 Homeobox 1 (homeobox protein) (syn: TTF1, thyroid transcription factor-1) (syn: TEBP, thyroid-specific enhancer-binding protein) *a nuclear transcription factor *localized to nuclei *marker for multiple epithelial cells: bronchiolar, acinar, sacular, and alveolar epithelial cells	E16.5	TS24
	E18.5	TS26

P7

TS28

P28

TS28

Lung Developmental Stage	Term
--------------------------	------

late pseudoglandular	Bronchiole
	Distal bronchiole
	Terminal bronchiole
	Pre-alveolar parenchyma
	Acinar tubule
	Proximal acinar tubule
	Distal acinar tubule / bud
	Bronchiolar epithelium
	Acinar tubule epithelium
	Bronchiolar epithelial cell
	Acinar tubule epithelial cell
	Type I pneumocyte, immature (<i>HOPX</i> +)
	Type II pneumocyte, immature (<i>SFTPC</i> +)
	Intermediate pneumocyte (<i>SFTPC</i> +, <i>HOPX</i> +)
	Nucleus

^ pneumocyte expressing both type I and type

early saccular	Bronchiole
	Distal bronchiole
	Terminal bronchiole
	Pre-alveolar parenchyma
	Transitory duct
	Terminal sacculle
	Bronchiolar epithelium
	Terminal sacculle epithelium
	Bronchiolar epithelial cell
	Ciliated cell
	Club cell
	Terminal sacculle epithelial cell
	Type I pneumocyte, immature (<i>HOPX</i> +)
	Type II pneumocyte, immature (<i>SFTPC</i> +)
	Intermediate pneumocyte (<i>SFTPC</i> +, <i>HOPX</i> +)
Nucleus	

alveolar

Bronchiole
Distal bronchiole
Terminal bronchiole
Alveolar parenchyma
Alveolar duct
Alveolus
Bronchiolar epithelium
Alveolar epithelium
Bronchiolar epithelial cell
Ciliated cell
Club cell
Alveolar epithelial cell
Type I pneumocyte (*HOPX* +)
Type II pneumocyte (*SFTPC* +)
Nucleus

mature alveoli

Bronchiole
Distal bronchiole
Terminal bronchiole
Alveolar parenchyma
Alveolar duct
Alveolus
Bronchiolar epithelium
Alveolar epithelium
Bronchiolar epithelial cell
Ciliated cell
Club cell
Alveolar epithelial cell
Type I pneumocyte (*HOPX* +)
Type II pneumocyte (*SFTPC* +)
Nucleus

Level		04_18_16
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	04_19_16
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	04_18_16
Tissue compartment	part_of	04_18_16
Tissue compartment	part_of	04_18_16
Cell type		04_18_16
Cell type		
Cell type		
Cell type		
Cell type		
Subcellular organelle or structure		

e I and type II cell markers, such as SFTPC and HOPX

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	04_19_16
Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Cell type		
Cell type		
Cell type		
Cell type		
Cell type		04_13_16
Cell type		04_13_16
Cell type		04_18_16
Subcellular organelle or structure		

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Cell type	
Cell type	
Cell type	
Cell type	
Cell type	
Subcellular organelle or structure	

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Cell type	
Cell type	
Cell type	
Cell type	
Cell type	
Subcellular organelle or structure	

Mouse Lung - Immunofluorescence staining patterns

Images on LungGENS

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
<p>pHisH3</p> <p>*phosphorylated Histone H3</p> <p>*localized to chromosomes in dividing/mitotic cells</p> <p>i.e., in the G2 phase of the cell cycle, during the transition to M phase, and is coincident with mitotic chromosome condensation</p> <p>*used to calculate mitotic index</p> <p>* localized to chromosomes</p> <p>* not a specific cell marker per se</p>	<p>E16.5</p> <p>E18.5</p> <p>P7</p>	<p>TS24</p> <p>TS26</p> <p>TS28</p>

P28

TS28

Lung Developmental Stage	Term
--------------------------	------

late pseudoglandular	Note: Moderately abundant positive cells
----------------------	---

Pulmonary artery

Pulmonary vein

Bronchiole

Pre-alveolar parenchyma

Acinar tubule

Arterial smooth muscle

Venous smooth muscle

Bronchiolar smooth muscle

Bronchiolar epithelium

Acinar tubule epithelium

Bronchiolar epithelial cell

Interstitial / stromal cell

Smooth muscle cell

Acinar epithelial cell

Type I pneumocyte, immature (*HOPX* +)

Type II pneumocyte, immature (*SFTPC* +)

Chromatin

Chromosome

Nucleosome

Nucleus

early saccular	Pulmonary artery (<i>sparse</i>)
----------------	------------------------------------

Pre-alveolar parenchyma (*sparse*)

Arterial smooth muscle

Interstitial tissue / mesenchyme

Interstitial cell, unclassified

Smooth muscle cell

Chromatin

Chromosome

Nucleosome

Nucleus

alveolar	Alveolar parenchyma (<i>sparse</i>)
----------	---------------------------------------

Alveolar septum (*sparse*)
Alveolar Interstitial tissue
Alveolar interstitial cell, unclassified
Fibroblast, unclassified
Chromatin
Chromosome
Nucleosome
Nucleus

mature alveoli

Alveolar parenchyma (*sparse*)
Alveolar septum (*sparse*)
Alveolar Interstitial tissue
Alveolar interstitial cell, unclassified
Fibroblast, unclassified
Chromatin
Chromosome
Nucleosome
Nucleus

Level

04_18_16

Anatomic structure

Anatomic structure

Anatomic structure

Anatomic structure

Anatomic structure

Tissue compartment

04_18_16

Tissue compartment

04_18_16

Tissue compartment

Tissue compartment

Tissue compartment

Cell type

Cell type

Cell type

Cell type

Cell type

Cell type

Subcellular organelle or structure

Subcellular organelle or structure

Subcellular organelle or structure

Subcellular organelle or structure

Anatomic structure

Anatomic structure

Tissue compartment

Tissue compartment

Cell type

Cell type

Subcellular organelle or structure

Subcellular organelle or structure

Subcellular organelle or structure

Subcellular organelle or structure

Anatomic structure

Anatomic structure

Tissue compartment

Cell type

Cell type

Subcellular organelle or structure

Subcellular organelle or structure

Subcellular organelle or structure

Subcellular organelle or structure

Anatomic structure

Anatomic structure

Tissue compartment

Cell type

Cell type

Subcellular organelle or structure

Subcellular organelle or structure

Subcellular organelle or structure

Subcellular organelle or structure

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

Probe

Age

SCGB1A1

E16.5

Secretoglobin, family 1A, member 1

(syn: CCSP, Clara cell secretory protein)

(syn: UGB, uteroglobin)

(syn: CC10, Clara-cell specific 10-kD protein)

*secretory protein, binds PC, PI; inhibitor of phospholipase A2

***localized to secretory granules**

***cell marker for nonciliated secretory cells in
conducting airway, a.k.a. Club cells**

E18.5

P7

P28

Mouse Embryonic Development Theiler Stages (TS)	Lung Developmental Stage
TS24	late pseudoglandular
TS26	early saccular
TS28	alveolar
TS28	mature alveoli

Term	Level	
Bronchiole (<i>sparse</i>)	Anatomic structure	part_of
Bronchiolar epithelium	Tissue compartment	part_of
Club cell, immature	Cell type	
Cytoplasm / secretory pathway	Subcellular organelle or structure	

Bronchiole (<i>moderately abundant</i>)	Anatomic structure	part_of
Proximal bronchiole	Anatomic structure	part_of
Distal bronchiole	Anatomic structure	part_of
Terminal bronchiole	Anatomic structure	part_of
Bronchiolar epithelium	Tissue compartment	part_of
Club cell, immature	Cell type	
Secretory granules	Subcellular organelle or structure	

Bronchiole (<i>very abundant</i>)	Anatomic structure	part_of
Proximal bronchiole	Anatomic structure	part_of
Distal bronchiole	Anatomic structure	part_of
Terminal bronchiole	Anatomic structure	part_of
Bronchiolar epithelium	Tissue compartment	part_of
Club cell, mature	Cell type	
Secretory granules	Subcellular organelle or structure	

Bronchiole (<i>very abundant</i>)	Anatomic structure	part_of
Proximal bronchiole	Anatomic structure	part_of
Distal bronchiole	Anatomic structure	part_of
Terminal bronchiole	Anatomic structure	part_of
Bronchiolar epithelium	Tissue compartment	part_of

Club cell, mature
Secretory granules

Cell type
Subcellular organelle or structure

04_18_16

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

Probe

Age

SFTPC

E16.5

Surfactant, pulmonary-associated protein C

(syn: SP-C, surfactant protein C)

*hydrophobic peptide associated with surfactant

phospholipids, secreted into the alveolar lumen where it
reduces surface tension at the alveolar surface

***localized to multivesicular and lamellar bodies**

***cell marker for immature and mature type II pneumocytes
and bipotential pneumocytes**

E18.5

P7

P28

Mouse Embryonic Development Theiler Stages (TS)	Lung Developmental Stage
--	--------------------------

TS24	late pseudoglandular
------	----------------------

TS26	early saccular
------	----------------

TS28	alveolar
------	----------

TS28	mature alveoli
------	----------------

Term

Pre-alveolar parenchyma

Acinar tubule

Distal acinar tubule / bud

Acinar tubule epithelium

Distal acinar tubule epithelium

Type II pneumocyte, immature (>intermediate pneumocyte)

Intermediate pneumocyte (SFTPC+, HOPX+)

Multivesicular body

Immature / forming lamellar body

Pre-alveolar parenchyma

Transitory duct

Terminal saccule (> transitory duct)

Terminal saccule epithelium

Type II pneumocyte, immature (> intermediate pneumocyte)

Intermediate pneumocyte (SFTPC+, HOPX+) RARE

Multivesicular bodies

Immature / forming lamellar body

Lamellar body

Alveolar parenchyma

Alveolar duct

Alveolus (> alveolar duct)

Alveolar epithelium

Type II pneumocyte

Multivesicular body

Lamellar body

Alveolar parenchyma

Alveolar duct

Alveolus (> alveolar duct)

Alveolar epithelium

Type II pneumocyte

Multivesicular body

Lamellar body

Level	04_18_16
-------	----------

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Tissue compartment	part_of	
Cell type		04_13_16
Cell type		04_13_16
Subcellular organelle or structure		04_18_16
Subcellular organelle or structure		04_18_16

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	04_18_16
Tissue compartment	part_of	
Cell type		04_13_16
Cell type		04_13_16
Subcellular organelle or structure		
Subcellular organelle or structure		04_18_16
Subcellular organelle or structure		04_18_16

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	04_18_16
Tissue compartment	part_of	
Cell type		
Subcellular organelle or structure		
Subcellular organelle or structure		

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	04_18_16
Tissue compartment	part_of	

Cell type

Subcellular organelle or structure

04_18_16

Subcellular organelle or structure

04_18_16

Mouse Lung - Immunofluorescence staining patterns
Images on LungGENS

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
SOX2 SRY(sex determining region Y)-BOX 2 *nuclear transcription factor *localized to nuclei * marker for multiple epithelial cells: subsets of bronchiolar epithelial cells Note: proximal-to-distal gradient of decreasing expression levels at E16.5 & E18.5	E16.5	TS24
	E18.5	TS26
	P7	TS28
	P28	TS28

Lung Developmental Stage	Term
--------------------------	------

late pseudoglandular	<p>Bronchiole (<i>Prox > distal > terminal gradient</i>)</p> <p>Proximal bronchiole (<i>strong</i>)</p> <p>Distal bronchiole (<i>weak</i>)</p> <p>Terminal bronchiole (<i>weak</i>)</p> <p>Bronchiolar epithelium</p> <p>Bronchiolar epithelial cells</p> <p>Nucleus</p>
----------------------	--

saccular	<p>Bronchiole (<i>Prox > distal > terminal gradient</i>)</p> <p>Proximal bronchiole (<i>strong</i>)</p> <p>Distal bronchiole (<i>weak</i>)</p> <p>Terminal bronchiole (<i>weak</i>)</p> <p>Bronchiolar epithelium</p> <p>Bronchiolar epithelial cells</p> <p>Nucleus</p>
----------	--

alveolar	<p>Bronchiole</p> <p>Bronchiolar epithelium</p> <p>Bronchiolar epithelial cells</p> <p>Nucleus</p>
----------	--

staining problematic - background precipitate

mature alveoli	<p>Bronchiole</p> <p>Bronchiolar epithelium</p> <p>Bronchiolar epithelial cells</p> <p>Nucleus</p>
----------------	--

staining problematic - background precipitates

Level		04_18_16
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	04_18_16
Anatomic structure	part_of	04_18_16
Tissue compartment	part_of	04_18_16
Cell type		04_18_16
Subcellular organelle or structure		04_18_16

Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Anatomic structure	part_of	
Tissue compartment	part_of	
Cell type		
Subcellular organelle or structure		

Anatomic structure	part_of	
Tissue compartment	part_of	
Cell type		
Subcellular organelle or structure		

precipitate on tissue

Anatomic structure	part_of	
Tissue compartment	part_of	
Cell type		
Subcellular organelle or structure		

precipitates on tissue

Mouse Lung - Immunofluorescence staining patterns

Images on LungGENS

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
SOX9 SRY(sex determining region Y)-BOX 9 *nuclear transcription factor * localized to the nucleus * marker for distal acinar epithelial cells and peribronchiolar connective tissue fibroblasts	E16.5	TS24
* marker for terminal saccule epithelial cells, peribronchial and peribronchiolar connective tissue fibroblasts, and chondrocytes in bronchial cartilage	E18.5	TS26
* marker for peribronchiolar connective tissue cells	P7	TS28

*marker for peribronchiolar
connective tissue cells and cells in the
alveolar parenchyma

P28

TS28

Lung Developmental Stage Term

late pseudoglandular

- Bronchiole
- Pre-alveolar parenchyma
- Distal acinar tubule / bud
- Peribronchiolar connective tissue
- Distal acinar tubule epithelium
- Fibroblast, unclassified
- Distal acinar tubule/bud epithelial cell
- Type II pneumocyte, immature (*SOX9+*, *SFTPC+* cells, abundant)
- Nucleus

early saccular

- Bronchus
- Bronchiole
- Pre-alveolar parenchyma
- Terminal sacculle
- Distal terminal sacculle
- Cartilage
- Peribronchiolar connective tissue
- Terminal sacculle epithelium
- Chondrocyte
- Fibroblast, unclassified
- Terminal sacculle epithelial cell
- Type II pneumocyte, immature (*SOX9+*, *SFTPC+* cells, sparse)
- Nucleus

alveolar

- Bronchiole
- Peribronchiolar connective tissue
- Fibroblast, unclassified
- Nucleus

mature alveoli

Bronchiole (*sparse*)

Alveolar parenchyma (*sparse*)

Alveolus (*sparse*)

Peribronchiolar connective tissue

Fibroblast, unclassified

Type II pneumocyte (*SOX9+*, *SFTPC+*, *very rare*)

Nucleus

Level 04_18_16

Anatomic structure adjacent_to
Anatomic structure part_of
Anatomic structure part_of
Tissue compartment part_of 04_18_16
Tissue compartment part_of 04_18_16
Cell type 04_18_16
Cell type 04_18_16
Cell type
Subcellular organelle or structure

Anatomic structure adjacent_to 04_18_16
Anatomic structure adjacent_to 04_18_16
Anatomic structure part_of 04_18_16
Anatomic structure part_of 04_18_16
Anatomic structure part_of 04_18_16
Tissue compartment part_of
Tissue compartment part_of
Tissue compartment part_of
Cell type
Cell type
Cell type
Cell type
Subcellular organelle or structure

Anatomic structure adjacent_to 04_18_16
Tissue compartment part_of 04_18_16
Cell type
Subcellular organelle or structure

Anatomic structure	adjacent_to
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Cell type	
Cell type	
Subcellular organelle or structure	

Mouse Lung - Immunofluorescence staining patterns

Images on LungGENS

Probe	Age	Mouse Embryonic Development Theiler Stages (TS)
TUBA1A Tubulin, alpha-1A (acetylated) *GTPase enzymatic activity *cytoskeleton / microtubules / ciliary axoneme *localized to cilia and microtubules * cell marker for ciliated cells and nerve fibers	E16.5	TS24
	E18.5	TS26
	P7	TS28
	P28	TS28

Lung Developmental Stage	Term
--------------------------	------

late pseudoglandular	Bronchiole (<i>sparse</i>) Nerve Bronchiolar epithelium Peribronchiolar connective tissue Ciliated cell (<i>sparse</i>) Nerve fiber Cilia /ciliary axoneme Microtubules
----------------------	---

early saccular	Bronchiole (<i>prox > distal gradient</i>) Proximal bronchiole Distal bronchiole Terminal bronchiole (+/-) Nerve Bronchiolar epithelium Peribronchiolar connective tissue Ciliated cell Nerve fiber Cilia /ciliary axoneme Microtubules
----------------	---

alveolar	Bronchiole (<i>prox > distal gradient</i>) Proximal bronchiole Distal bronchiole Terminal bronchiole (+/-) Bronchiolar epithelium Ciliated cell Cilia /ciliary axoneme Microtubules
----------	---

Note: No visible nerve fibers at P07

mature alveoli	Bronchiole (<i>prox > distal gradient</i>)*
----------------	---

Proximal bronchiole
Distal bronchiole
Bronchiolar epithelium
Ciliated cell
Cilia /ciliary axoneme
Microtubules

***not found in terminal bronchioles**

Note: No visible nerve fibers at P28

Level

04_18_16

Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Cell type	
Subcellular organelle or structure	
Subcellular organelle or structure	

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Cell type	
Subcellular organelle or structure	
Subcellular organelle or structure	

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	
Subcellular organelle or structure	

Anatomic structure	part_of
--------------------	---------

Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	
Subcellular organelle or structure	

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

Probe

Age

ABCA3

E16.5

ATP-Binding Cassette, subfamily A ,member 3

(syn: ATP-Binding Cassette Transporter 3; ABC Transporter 3)

* a 1,704-amino acid polypeptide with 2 homologous repeats, each harboring 6 putative transmembrane helices and an ATP-binding domain.

E18.5

*required for lamellar body formation, i.e.,for lipid (phospholipid and cholesterol) transport into the lamellar body, the storage form of pumonary surfactant

***localized to the limiting (outer) membrane of the lamellar body**

***cell marker for immature and mature type II pneumocytes**

P7

P28

Mouse Embryonic Development Theiler Stages (TS)	Lung Developmental Stage
TS24	late pseudoglandular
TS26	early saccular
TS28	alveolar
TS28	mature alveoli

Term

No expression of protein detected

Pre-alveolar parenchyma

Transitory duct

Terminal saccule (*> transitory duct*)

Terminal saccule epithelium

Type II pneumocyte, immature

Immature / forming lamellar body

Lamellar body

Alveolar parenchyma

Alveolar duct

Alveolus (*> alveolus*)

Alveolar epithelium

Type II pneumocyte

Lamellar body

Alveolar parenchyma

Alveolar duct

Alveolus (*> alveolus*)

Alveolar epithelium

Type II pneumocyte

Lamellar body

Level

N/A

Anatomic structure

part_of

Anatomic structure

part_of

Anatomic structure

part_of

Tissue compartment

part_of

Cell type

Subcellular organelle or structure

Subcellular organelle or structure

Anatomic structure

part_of

Anatomic structure

part_of

Anatomic structure

part_of

Tissue compartment

part_of

Cell type

Subcellular organelle or structure

Anatomic structure

part_of

Anatomic structure

part_of

Anatomic structure

part_of

Tissue compartment

part_of

Cell type

Subcellular organelle or structure

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

Probe

Age

AGER

E16.5

Advanced Glycosylation End Product-specific Receptor

(syn: RAGE, Receptor for Advanced Glycation End Products)

*a multi-ligand member of the immunoglobulin superfamily

*integral transmembrane protein / receptor

* localized to the cell surface / plasma membrane

*cell marker for type I pneumocytes

E18.5

P7

P28

P28

**Mouse Embryonic Development
Theiler Stages (TS)**

Lung Developmental Stage

TS24 late pseudoglandular

TS26 early saccular

TS28 alveolar

TS28 mature alveoli

TS28 mature alveoli

Term

Pre-alveolar parenchyma

Acinar tubule

Proximal acinar tubule (*not uniformly expressed in all acinar tubules*)

Proximal acinar tubule epithelium (*basal surface*)

Proximal acinar epithelial cell

Type I pneumocyte, immature

Plasma membrane / basal epithelial cell membrane

Pre-alveolar parenchyma

Transitory duct

Terminal saccule (*proximal > distal*)

Transitory duct epithelium

Terminal saccule epithelium (*apical surface*)

Type I pneumocyte, immature

Plasma membrane / apical epithelial cell membrane

Alveolar parenchyma

Alveolar duct

Alveolus

Alveolar epithelium (*apical surface*)

Type I pneumocyte

Plasma membrane / apical epithelial cell membrane

Alveolar parenchyma

Alveolar duct

Alveolus

Alveolar epithelium (*apical surface*)

Type I pneumocyte

Plasma membrane / apical epithelial cell membrane

Alveolar parenchyma

Alveolar duct

Alveolus

Alveolar epithelium (*apical surface*)

Type I pneumocyte

Plasma membrane / apical epithelial cell membrane

Level

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Cell type	
Cell type	
Subcellular organelle or structure	

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	

Anatomic structure	part_of
Anatomic structure	part_of

Anatomic structure	part_of
Tissue compartment	part_of
Cell type	
Subcellular organelle or structure	

Mouse Lung - Immunofluorescence staining patterns

Images on LungIMAGE

Probe

Age

VIM

E16.5

Vimentin

*Member of the intermediate filament family

***intracellular, cytoskeletal type III intermediate filament**

***cell marker for mesenchyme-derived cells (except for muscle that expresses desmin)**

E18.5

P7

P28

Note: analysis incomplete - needs additional dual staining to confirm initial assessment

Mouse Embryonic Development Theiler Stages (TS)	Lung Developmental Stage	Term
TS24	late pseudoglandular	Pre-alveolar parenchyma Intra-parenchymal blood vessel Pre-alveolar acinar capillary bed Pulmonary artery Pulmonary vein Interstitial tissue / mesenchyme Artery endothelium Capillary endothelium Vascular endothelium Venous endothelium Endothelial cell Pericyte Cytoplasm / intermediate filament
TS26	early saccular	Lymphatic vessel Pulmonary artery Pulmonary vein Pre-alveolar parenchyma Intra-parenchymal blood vessel Pulmonary arteriole Pulmonary venule Pre-alveolar sacculi capillary bed Terminal sacculi (<i>lumen</i>) Interstitial tissue / mesenchyme Arteriole endothelium Artery endothelium Capillary endothelium Lymphatic endothelium Vascular endothelium Venous endothelium Venule endothelium Alveolar macrophage Endothelial cell

		Fibroblast, unclassified Pericyte Cytoplasm / intermediate filament
TS28	alveolar	Alveolus Alveolar parenchyma Primary alveolar septum Secondary alveolar septum Alveolar septal crest Pulmonary artery Interstitial tissue / mesenchyme Alveolar macrophage Fibroblast, unclassified Cytoplasm / intermediate filament
TS28	mature alveoli	Alveolus Alveolar parenchyma Alveolar septum Pulmonary artery Interstitial tissue / mesenchyme Alveolar macrophage Fibroblast, unclassified Cytoplasm / intermediate filament

Level

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Cell type	
Subcellular organelle or structure	

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Tissue compartment	part_of
Cell type	
Cell type	

Cell type
Cell type
Subcellular organelle or structure

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of

Cell type
Cell type
Subcellular organelle or structure

Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Anatomic structure	part_of
Tissue compartment	part_of

Cell type
Cell type
Subcellular organelle or structure