

## Online supplemental material

*Supplemental Figure 1:* IL-22+ T cells comprise about one third “pure” Th22 cells.

A) Algorithm to calculate the relative frequency of Th22 cells within the cellular infiltrate of inflammatory skin diseases. A representative 4-color intracellular staining of skin-infiltrating T cells shows the relative frequency of IL-22+IL-17- and of IL-22+IL-17+ T cells, in the example 15,94% (I). The relative frequency of Th22 within total T cellular infiltrate is calculated as the percentage of IL-22+IL-17- cells (dot plot I, 7,4%) that are also negative for IFN- $\gamma$  and IL-4 (lower left quadrant of dot plot II, 41,2% of IL-22+IL-17- cells). The relative frequency of Th22 within total IL-22+ cells is calculated as Th22/total IL-22+ cells, in the shown example 19,1% (III). B) Relative frequency of Th22 cells within IL-22+ T cells in peripheral blood (PBMC, n=4), Psoriasis (PS, n=3), atopic eczema (AE, n=4) and contact dermatitis (ACD, n=4). Shown are mean percentages +/- standard error of the mean.

*Supplemental Figure 2:* Surface phenotype of Th22 clones. The surface phenotype of the Th22 clones shown in Figure 2 was further analysed by flow cytometry. Shown are representative flow cytometric stainings of clone 1(a), clone 2 (b) and clone 3 (c) in resting state (red lines) as compared to isotype control (blue lines).

*Supplemental Figure 3:* Th22 clones were cultured under Th1, Th2, Th17 and Treg conditions. 4 color-intracellular staining after PMA/ionomycin stimulation after 4 and 7 days shows that Th22 conserved a high secretion of IL-22 (x-axis of dot plots), but did not gain the capacity to produce substantial amounts of another lineage-indicating cytokine (y-axes of dot plots) despite a slight increase in IFN- $\gamma$ . Data shown are representative and show “clone 3” (Fig 2c).

*Supplemental Figure 4:* Th22 cells are stable and cannot be deformed into other T cell phenotypes. Freshly isolated Th22 cells are stable under different T helper subset-polarizing conditions. Th22 cells from peripheral blood of three different donors were enriched by isolating CD45RA-CCR10<sup>+</sup> T cells and cultured under Th1, Th2, Th17,

Th22 and Treg conditions. After 5 days, they were stimulated with anti-CD3/anti-CD28 for 48 hours, and cytokine content was measured by ELISA (a) or stimulated with PMA/Ionomycine and stained intracellularly (b). Cytokine content of cell-free supernatant is given in the y-axes. As recombinant cytokines were added, TNF- $\alpha$  under Th22 and IL-4 under Th2 conditions is not shown (marked with "X"). Shown are three independent experiments. Error bars indicate Standard error of the mean.

*Supplemental Table 1:* Quantity of distinct T cell phenotypes and plasticity of T cell subsets varies among inflammatory skin disorders. Shown are relative percentages of primary human T lymphocytes derived from psoriasis (n=3), AE (n=4), and ACD (n=4) that stain positive for IL-22, IL-17, IFN- $\gamma$  and IL-4 in 4 color-intracellular stainings, as shown in the Venn blot in figure 1f.

*Supplemental Table 2:* Primer sequences used for real time PCR analysis.

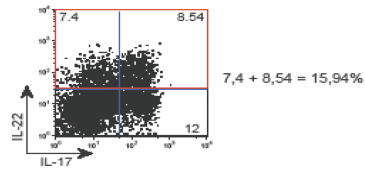
*Supplemental Table 3:* Bioinformatic extraction of genes up- or downregulated in Th22 clones (n = 3) in comparison to effector T cell clones (n = 5). Genes, which were at least two-fold up- or downregulated entered the analysis. The functional groups were filtered using the Biblioshere software (Genomatix). All tables were curated and corrected for double assignments.

*Supplemental Table 4:* Bioinformatic extraction of genes up- or downregulated in keratinocytes upon exposure to Th22 supernatants in comparison to medium. Genes that were at least two-fold up- or downregulated entered the analysis. The functional groups were filtered using the Biblioshere software (Genomatix). All tables were curated and corrected for double assignments.

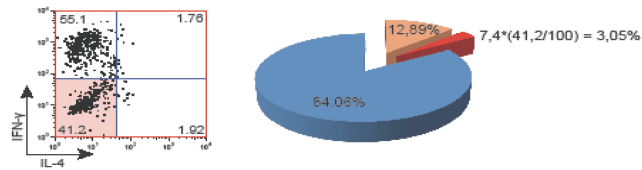
Supplemental figure 1

A

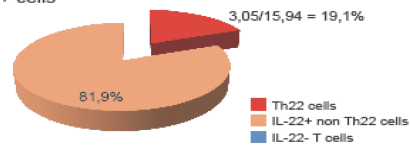
I. Total IL-22+ cells



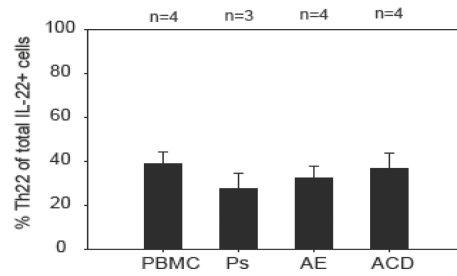
II. Fraction of Th22 cells on total T cells



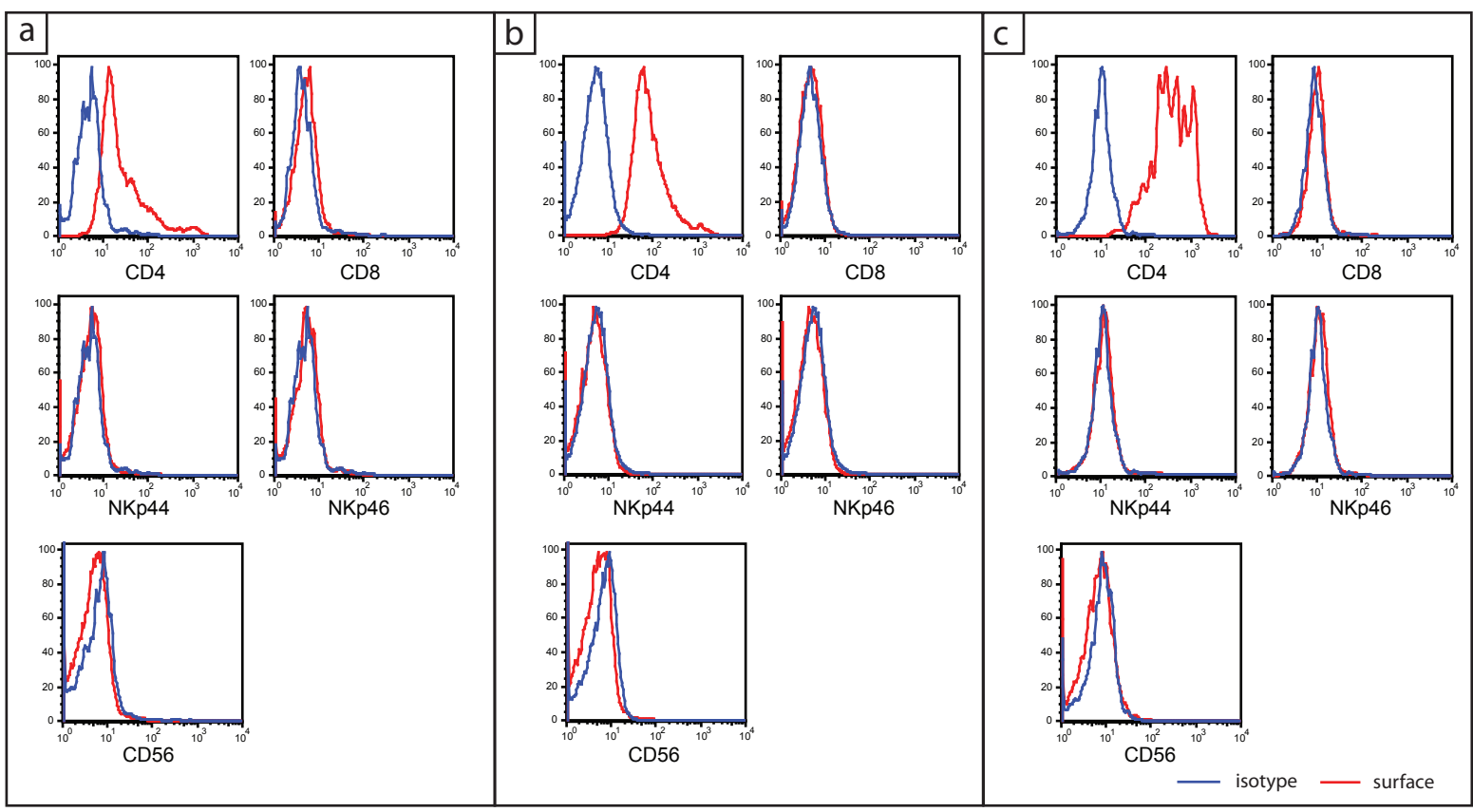
III. Fraction of Th22 cells on IL-22+ cells



B



Supplemental Figure 2

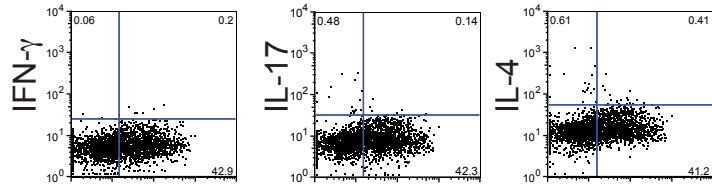


% of Max

### Th22 clones under deforming conditions

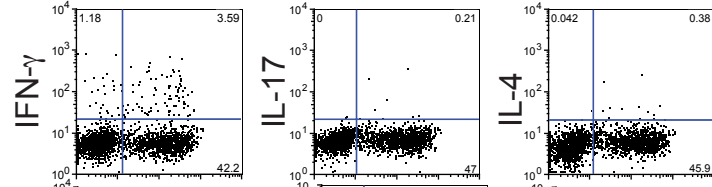
DAY 0

np conditions

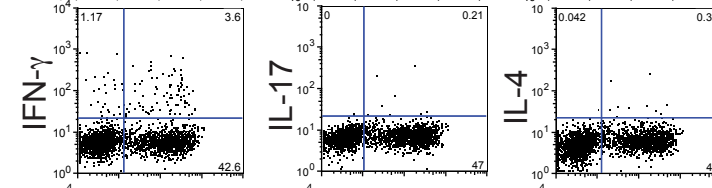


DAY 4

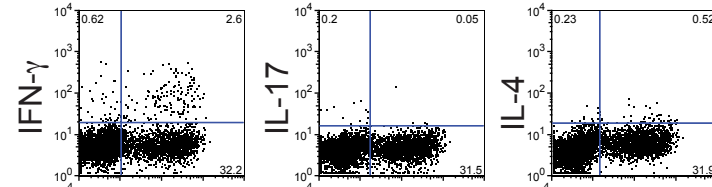
neutral conditions  
(medium)



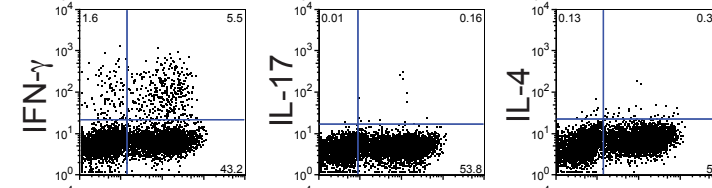
T<sub>H</sub>1 conditions  
(IL-12 +  $\alpha$ -IL-4)



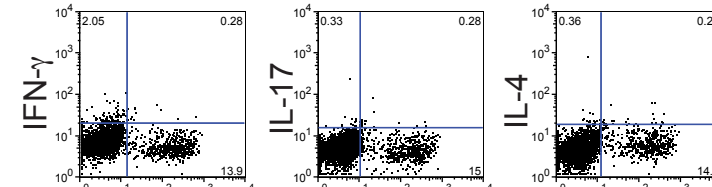
T<sub>H</sub>2 conditions  
(IL-4 +  $\alpha$ -IL-12)



T<sub>H</sub>17 conditions  
(IL-1 $\beta$  + IL-6 +  $\alpha$ -IFN- $\gamma$  +  $\alpha$ -IL-4)



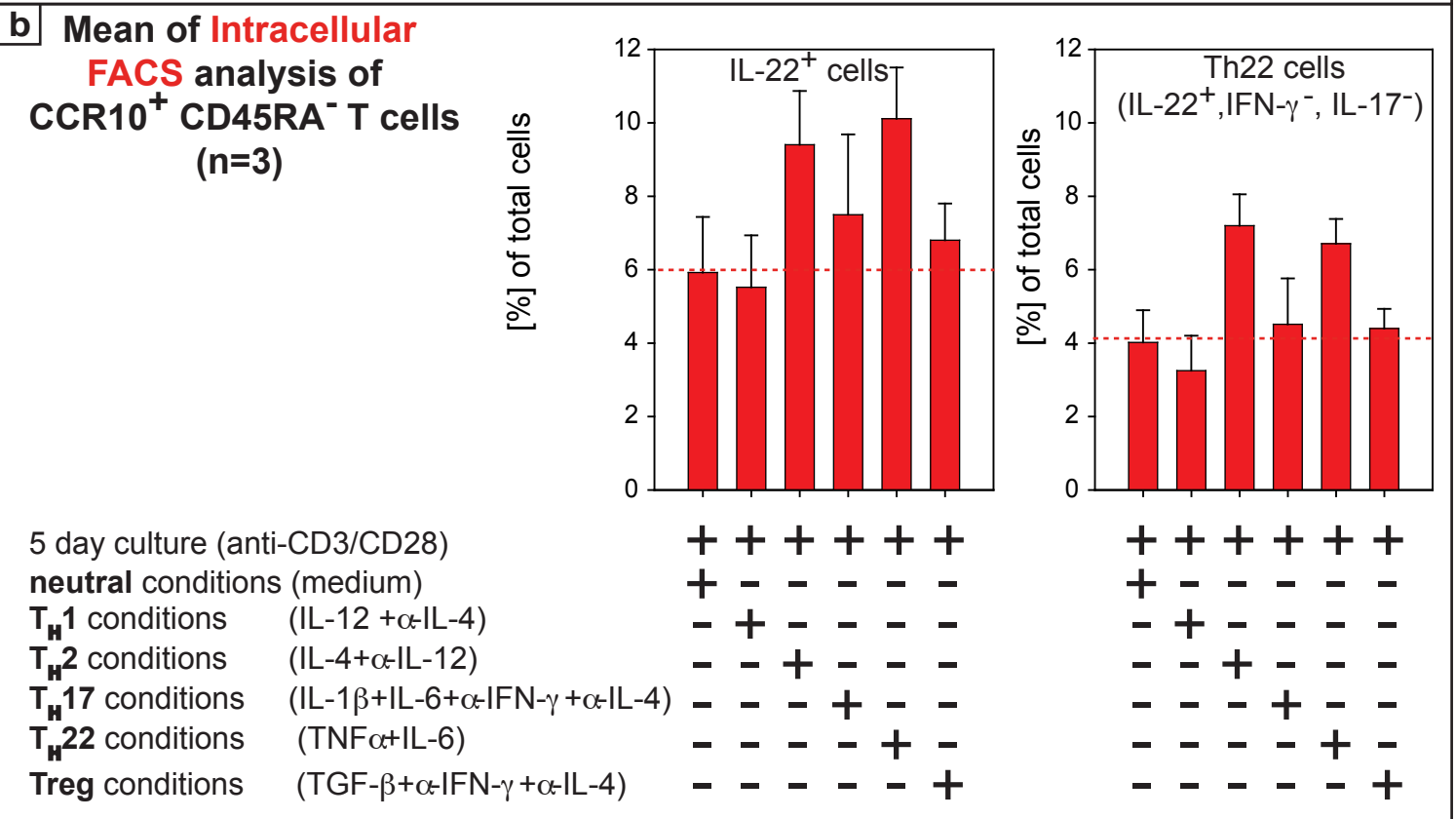
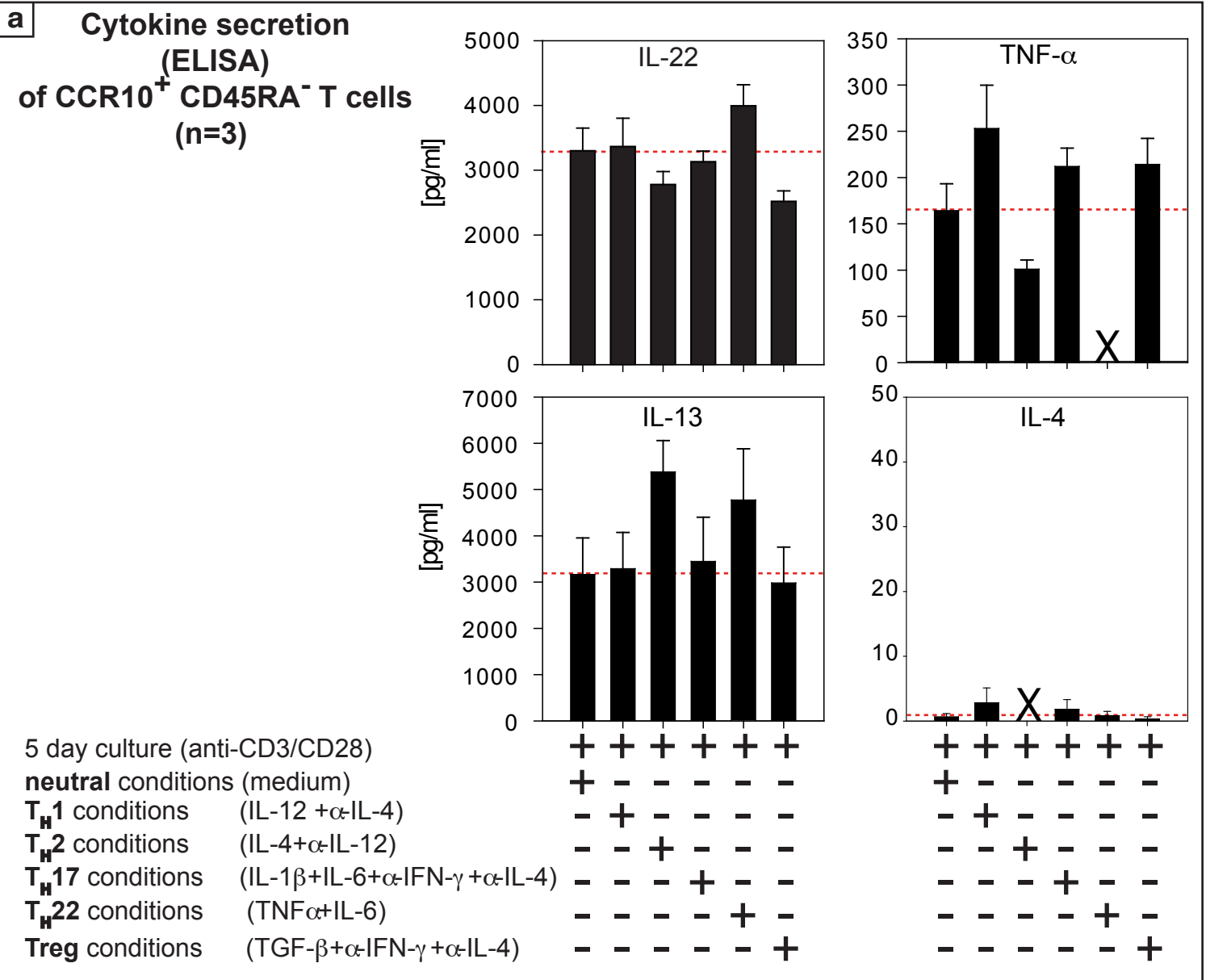
Treg conditions  
(TGF- $\beta$  +  $\alpha$ -IFN- $\gamma$  +  $\alpha$ -IL-4)



IL-22

IL-22

IL-22



Supplemental Table 1

% positive cells	Psoriasis	Atopic Eczema	Contact Dermatitis
IFN- $\gamma$	34.3	30.1	36.4
IL-4	5.3	30.5	15.6
IL-17	17.4	9.0	13.1
IL-22	15.9	12.1	13.7
IFN- $\gamma$ /IL-4	2.6	9.5	6.3
IFN- $\gamma$ /IL-17	9.1	4.6	6.2
IFN- $\gamma$ /IL-22	9.2	3.9	5.4
IL-4/IL-17	1.0	2.1	1.1
IL-4/IL-22	0.3	1.2	0.4
IL-17/IL-22	9.4	2.1	4.4
IFN- $\gamma$ /IL-4/IL-17	0.03	0.5	0.6
IFN- $\gamma$ /IL-4/IL-22	0.05	0.4	0.2
IFN- $\gamma$ /IL-17/IL-22	4.0	0.5	1.4
IL-4/IL-17/IL-22	0.01	0.1	0.1
IFN- $\gamma$ /IL-4/IL-17/IL-22	0.01	0.05	0.06

Supplemental Table 2

<b>name</b>	<b>forward primer</b>	<b>reverse primer</b>
CXCL9	TCACATCTGCTGAATCTGGG	CCTTAAACAATTTGCCCAA
CXCL10	GCTGATGCAGGTACAGCGT	CACCATGAATCAAAGTGC
CXCL11	ATGCAAAGACAGCGTCCTCT	CAAACATGAGTGTGAAGGGC
CCL2	AGGTGACTGGGGCATTGAT	GCCTCCAGCATGAAAGTCTC
CCL5	TGTACTCCCGAACCATTTC	TACACCAGTGGCAAGTGCTC
CCL20	CGTGTGAAGCCCACAATAAA	GTGCTGCTACTCCACCTCTG
CCL26	ATCAGGCCCTTCTCAGGTTT	AATTGAGGCTGAGCCAAAGA
C1s	CAAAGGGTTCTCTGGGGACT	TGGGGAGTATCACTGTGCTG
C1r	TCCCAGGCTTTTCTTATCA	GAAGCTCGTCTTCCAGCAGT
CFH	TCGCTTTTTCTTTAAGGCA	CCAGATGCATCCGTGTCA
CFB	GGTTGCTTGTGGTAATCGGT	TGGAAAACCTGGAAGATGTTT
S100A7	GCTGACGATGATGAAGGAGAACT	GTAATTTGTGCCCTTTTGTACA
TLR3	AGTGCACTTGGTGGTGGAG	AGGAAAGGCTAGCAGTCATCC
TLR6	AGCAGAGTGGAGAGGAGCTG	CCTGCCAGTTAGAGACAGCC
IL-7	TCATTATTCAGGCAATTGCTACC	TGAAGGTAAAGATGGCAAACAA
IL-15	TCCACGATGCCTCCTACAA	TGTTCCATCATGTTCCATGC
IL-32	CTG AAG GCC CGA ATG CAC CAG	GCA AAG GTG GTG TCA GTA TC



**Suppl. table 3****S. Foerster et al: Genes regulated in Th22 cells**

<b>gene symbol</b>	<b>Th22-specific, up-regulated immuno relevant genes</b>	<b>identifier</b>
FGF5	fibroblast growth factor 5	2250
FGF17	fibroblast growth factor 17	8822
FGFR2	fibroblast growth factor receptor 2	2263
THPO	thrombopoietin	7066
AREG	amphiregulin	374
BTC	betacellulin (EGF-R ligand)	685
UTS2	urotensin 2	10911
CCL15	chemokine (C-C motif) ligand 15	6359
CCL7	chemokine (C-C motif) ligand 7	6354
MMP2	matrix metalloproteinase 2 (gelatinase A, 72kDa gelatinase, 72kDa type IV collagenase)	4313
MMP13	matrix metalloproteinase 13 (collagenase 3)	4322
MMP12	matrix metalloproteinase 12 (macrophage elastase)	4321
TLR4	toll-like receptor 4	7099
PTGER3	prostaglandin E receptor 3 (subtype EP3)	5733
PDGFRB	platelet-derived growth factor receptor, beta polypeptide	5159
TIE1	tyrosine kinase with immunoglobulin-like and EGF-like domains 1	7075

<b>gene symbol</b>	<b>Th22-specific, up-regulated transcriptional regulators</b>	<b>identifier</b>
BNC2	basonuclin 2	54796
FOXO4	forkhead box O4	4303
BCL6B	B-cell CLL/lymphoma 6, member B (zinc finger protein)	255877
HOXB8	homeobox B8	3218
POU1F1	POU class 1 homeobox 1	5449
NEUROG2	neurogenin 2	63973
SOX13	SRY (sex determining region Y)-box 13	9580
MED14	mediator complex subunit 14	9282
MED18	mediator complex subunit 18	54797
HDAC9	histone deacetylase 9	9734

<b>gene symbol</b>	<b>Th22-specific, up-regulated enzymes</b>	<b>identifier</b>
HSD17B11	hydroxysteroid (17-beta) dehydrogenase 11	51170
PPEF1	protein phosphatase, EF-hand calcium binding domain 1	5475
MEP1B	mepirin A, beta (metalloendopeptidase, Plasma membrane)	4225
A4GALT	alpha 1,4-galactosyltransferase	53947
ICEBERG	ICEBERG caspase-1 inhibitor	59082
PAH	phenylalanine hydroxylase	5053
PON2	paraoxonase 2	5445

### Suppl. table 3

#### S. Foerster et al: Genes regulated in Th22 cells

SULT2A1	sulfotransferase family, cytosolic, 2A, dehydroepiandrosterone -preferring, member 1	6822
MYLK	myosin light chain kinase	4638
TIE1	tyrosine kinase with immunoglobulin-like and EGF-like domains 1	7075
AK5	adenylate kinase 5	26289
HPGD	hydroxyprostaglandin dehydrogenase 15-(NAD)	3248
SULT1B1	sulfotransferase family, cytosolic, 1B, member 1	27284
KLK2	kallikrein-related peptidase 2	3817
GARNL4	GTPase activating Rap/RanGAP domain-like 4	23108
PRKG1	protein kinase, cGMP-dependent, type I	5592
PDE2A	phosphodiesterase 2A, cGMP-stimulated	5138
USP2	ubiquitin specific peptidase 2	9099
AMPD1	adenosine monophosphate deaminase 1 (isoform M)	270

gene symbol	Th22-specific, up-regulated receptors	identifier
PPARGC1A	peroxisome proliferator-activated receptor gamma, coactivator 1 alpha	10891
SCN9A	sodium channel, voltage-gated, type IX, alpha subunit	6335
SCN3A	sodium channel, voltage-gated, type III, alpha subunit	6328
GRIA2	glutamate receptor, ionotropic, AMPA 2	2891
GRIA3	glutamate receptor, ionotropic, AMPA 3	2892
GRIN2B	glutamate receptor, ionotropic, N-methyl D-aspartate 2B	2904
GRIN2A	glutamate receptor, ionotropic, N-methyl D-aspartate 2A	2903
RAMP1	receptor (G protein-coupled) activity modifying protein 1	10267
CXADR	coxsackie virus and adenovirus receptor	1525
SORCS1	sortilin-related VPS10 domain containing receptor 1	114815
VIPR1	vasoactive intestinal peptide receptor 1	7433
GLRB	glycine receptor, beta	2743
SIDT1	SID1 transmembrane family, member 1	54847

gene symbol	Th22-specific, up-regulated housekeeping genes	identifier
CNTNAP4	contactin associated protein-like 4	85445
STARD8	StAR-related lipid transfer (START) domain containing 8	9754
SOSTDC1	sclerostin domain containing 1	25928
SLC40A1	solute carrier family 40 (iron-regulated transporter), member 1	30061
MAB21L1	mab-21-like 1 (C. elegans)	4081
FAM107A	family with sequence similarity 107, member A	11170
C10orf11	chromosome 10 open reading frame 11	83938
C15orf49	chromosome 15 open reading frame 49	63969

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OPHN1	oligophrenin 1	4983
SLC2A9	solute carrier family 2 (facilitated glucose transporter), member 9	56606
PCDH11Y	protocadherin 11 Y-linked	83259
CLSTN3	calsyntenin 3	9746
DLEC1	deleted in lung and esophageal cancer 1	9940
AKAP12	A kinase (PRKA) anchor protein (gravin) 12	9590
BEX5	BEX family member 5	340542
PLP1	proteolipid protein 1	5354
SPESP1	sperm equatorial segment protein 1	246777
OCRL	oculocerebrorenal syndrome of Lowe	4952
TRIM9	tripartite motif-containing 9	114088
SAMD3	sterile alpha motif domain containing 3	154075
C10orf63	chromosome 10 open reading frame 63	219670
CMYA5	cardiomyopathy associated 5	202333
SERPINA7	serpin peptidase inhibitor, clade A member 7	6906
F8	coagulation factor VIII, procoagulant component	2157
SLC25A29	solute carrier family 25, member 29	123096
DMD	dystrophin	1756
ATP1B4	ATPase, (Na <sup>+</sup> )/K <sup>+</sup> transporting, beta 4 polypeptide	23439
COL8A2	collagen, type VIII, alpha 2	1296
LAMA1	laminin, alpha 1	284217
LAMB3	laminin, beta 3	3914
GJA1	gap junction protein, alpha 1, 43kDa	2697
DNAH11	dynein, axonemal, heavy chain 11	8701
TJP1	tight junction protein 1 (zona occludens 1)	7082
TSPAN2	tetraspanin 2	10100
MYOM2	myomesin (M-protein) 2, 165kDa	9172

<b>gene symbol</b>	<b>Th22-specific, down-regulated immuno relevant genes</b>	<b>identifier</b>
SPRY1	sprouty homolog 1, antagonist of FGF signaling (Drosophila)	10252
IL12A	interleukin 12A, p35)	3592
IL10	interleukin 10	3586
IL8RB	interleukin 8 receptor, beta	3579
CCL20	chemokine (C-C motif) ligand 20	6364
CCR6	chemokine (C-C motif) receptor 6	1235
CXCL13	chemokine (C-X-C motif) ligand 13 (B-cell chemoattractant)	10563
MMP19	matrix metalloproteinase 19	4327
LAG3	lymphocyte-activation gene 3	3902

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IL1RL1	interleukin 1 receptor-like 1	9173
SCARB1	scavenger receptor class B, member 1	949
KLRF1	killer cell lectin-like receptor subfamily F, member 1	51348
GPR125	G protein-coupled receptor 125	166647
KCNA1	potassium voltage-gated channel, shaker-related subfamily, member 1	3736
KCNE3	potassium voltage-gated channel, Isk-related family, member 3	10008
ACCN2	amiloride-sensitive cation channel 2, neuronal	41
ADAMTS9	ADAM metalloproteinase with thrombospondin type 1 motif, 9	56999
ADAMTS20	ADAM metalloproteinase with thrombospondin type 1 motif, 20	80070

<b>gene symbol</b>	<b>Th22-specific, down-regulated kinases genes</b>	<b>identifier</b>
CDC42BPA	CDC42 binding protein kinase alpha (DMPK-like)	8476
CDKL2	cyclin-dependent kinase-like 2 (CDC2-related kinase)	8999
PTPN14	protein tyrosine phosphatase, non-receptor type 14	5784
STYK1	serine/threonine/tyrosine kinase 1	55359
PLCG2	phospholipase C, gamma 2 (phosphatidylinositol-specific)	5336
LYN	v-src-1 Yamaguchi sarcoma viral related oncogene homolog	4067
CALML4	calmodulin-like 4	91860
CAMKV	CaM kinase-like vesicle-associated	79012
MX1	myxovirus resistance 1, interferon-inducible protein p78 (mouse)	4599
IFIT2	interferon-induced protein with tetratricopeptide repeats 2	3433

<b>gene symbol</b>	<b>Th22-specific, down-regulated transcriptional regulators</b>	<b>identifier</b>
ZNF93	zinc finger protein 93	81931
SALL1	sal-like 1 (Drosophila)	6299
NR1D1	nuclear receptor subfamily 1, group D, member 1	9572
TEAD2	TEA domain family member 2	8463
TEAD4	TEA domain family member 4	7004
STON1-GTF2A1L	STON1-GTF2A1L	286749
CBFA2T3	core-binding factor, runt domain, alpha subunit 2; translocated to, 3	863
SOX5	SRY (sex determining region Y)-box 5	6660
SOX4	SRY (sex determining region Y)-box 4	6659
EOMES	eomesodermin homolog (Xenopus laevis)	8320
PPARGC1B	peroxisome proliferator-activated receptor gamma, coactivator 1 beta	133522
ZNF215	zinc finger protein 215	7762
ZNRF1	zinc and ring finger 1	84937
ZNF22	zinc finger protein 22 (KOX 15)	7570

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RNF128	ring finger protein 128	79589
ZAK	sterile alpha motif and leucine zipper containing kinase AZK	51776

<b>gene symbol</b>	<b>Th22-specific down-regulated transcriptional repressors</b>	<b>identifier</b>
NR1D1	nuclear receptor subfamily 1, group D, member 1	9572
ZNF253	zinc finger protein 253	56242
SIM2	single-minded homolog 2 (Drosophila)	6493
TRPS1	trichorhinophalangeal syndrome I	7227

<b>gene symbol</b>	<b>Th22-specific, down-regulated cellular genes</b>	<b>identifier</b>
LCP1	lymphocyte cytosolic protein 1 (L-plastin)	3936
GNAT2	G protein, alpha transducing activity polypeptide 2	2780
RHOBTB3	Rho-related BTB domain containing 3	22836
NDN	necdin homolog (mouse)	4692
TNS1	tensin 1	7145
FAM98B	family with sequence similarity 98, member B	283742
FEZ1	fasciculation and elongation protein zeta 1 (zygin I)	9638
CALD1	caldesmon 1	800
TPBG	trophoblast glycoprotein	7162
STON1	stonin 1	11037
MUC16	mucin 16, cell surface associated	94025
EPYC	epiphycan	1833
DDEF2	development and differentiation enhancing factor 2	8853
RTTN	rotatin	25914
KIF7	kinesin family member 7	374654
TWSG1	twisted gastrulation homolog 1 (Drosophila)	57045
SLC4A10	solute carrier family 4, sodium bicarbonate transporter-like, member 10	57282
EYA4	eyes absent homolog 4 (Drosophila)	2070
SGOL1	shugoshin-like 1 (S. pombe)	151648
PSEN2	presenilin 2 (Alzheimer disease 4)	5664
STON2	stonin 2	85439
B3GALNT1	beta-1,3-N-acetylgalactosaminyltransferase 1	8706
GAL	galanin prepropeptide	51083
PROK2	prokineticin 2	60675
XIRP2	xin actin-binding repeat containing 2	129446
SPON2	spondin 2, extracellular matrix protein	10417
PODXL2	podocalyxin-like 2	50512
DLGAP1	discs, large (Drosophila) homolog-associated protein 1	9229

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PLN	phospholamban	5350
RAD54B	RAD54 homolog B ( <i>S. cerevisiae</i> )	25788
MFI2	antigen p97 (melanoma associated) identified by monoclonal antibodies 133.2 and 96.5	4241
RFX6	regulatory factor X, 6	222546
STC2	stanniocalcin 2	8614
TUBB	tubulin, beta	203068
CASC5	cancer susceptibility candidate 5	57082

<b>gene symbol</b>	<b>Th22-specific, down-regulated housekeeping enzymes</b>	<b>identifier</b>
ATAD3B	ATPase family, AAA domain containing 3B	83858
ATP10A	ATPase, class V, type 10A	57194
ARL6IP2	ADP-ribosylation factor-like 6 interacting protein 2	64225
CKMT2	creatine kinase, mitochondrial 2 (sarcomeric)	1160
TOP1MT	topoisomerase (DNA) I, mitochondrial	116447
PHGDH	phosphoglycerate dehydrogenase	26227
LONRF2	LON peptidase N-terminal domain and ring finger 2	164832
GALNT1	UDP-N-acetyl-alpha-D-galactosamine:polypeptide N-acetylgalactosaminyltransferase 1 (GalNAc-T1)	2589
PLK4	polo-like kinase 4 ( <i>Drosophila</i> )	10733
COASY	Coenzyme A synthase	80347
MMEL1	membrane metallo-endopeptidase-like 1	79258
ME1	malic enzyme 1, NADP(+)-dependent, cytosolic	4199
STARD13	StAR-related lipid transfer (START) domain containing 13	90627
SOD2	superoxide dismutase 2, mitochondrial	6648

## Supplemental Table 4

### S. Foerster et al: Keratinocyte genes regulated by Th22 supernatants

gene symbol	Th22-supernatant-induced cytokines in keratinocytes	identifier
IFNK	interferon, kappa	56832
IL6	interleukin 6 (interferon, beta 2)	3569
IL7	interleukin 7	3574
IL15	interleukin 15	3600
IL24	interleukin 24	11009
IL32	interleukin 32	9235
FGF5	fibroblast growth factor 5	2250
BMP1	bone morphogenetic protein 1	649
GDNF	glial cell derived neurotrophic factor	2668
B2M	beta-2-microglobulin	567
ANGPTL4	angiopoietin-like 4	51129

gene symbol	Th22-supernatant-induced chemokines in keratinocytes	identifier
CCL5	chemokine (C-C motif) ligand 5	6352
CCL7	chemokine (C-C motif) ligand 7	6354
CCL2	chemokine (C-C motif) ligand 2	6347
CXCL10	chemokine (C-X-C motif) ligand 10	3627
CCL26	chemokine (C-C motif) ligand 26	10344
CX3CL1	chemokine (C-X3-C motif) ligand 1	6376
CXCL11	chemokine (C-X-C motif) ligand 11	6373
CCL20	chemokine (C-C motif) ligand 20	6364
CXCL9	chemokine (C-X-C motif) ligand 9	4283

gene symbol	Th22-supernatant-induced innate defense genes in keratinocytes	identifier
MUC1	mucin 1, cell surface associated	4582
MUC16	mucin 16, cell surface associated	94025
DEFB103A	defensin, beta 103A	55894
CFH	complement factor H	3075
CFHR3	complement factor H-related 3	10878
C1S	complement component 1, s subcomponent	716
C1R	complement component 1, r subcomponent	715
CFB	complement factor B	629
C1QTNF1	C1q and tumor necrosis factor related protein 1	114897
C1RL	complement component 1, r subcomponent-like	51279

## Supplemental Table 4

### S. Foerster et al: Keratinocyte genes regulated by Th22 supernatants

gene symbol	Th22-supernatant-induced structural genes in keratinocytes	identifier
COL8A1	collagen, type VIII, alpha 1	1295
COL5A1	collagen, type V, alpha 1	1289
COL1A2	collagen, type I, alpha 2	1278
LMNB1	lamin B1	4001
KRT6A	keratin 6A	3853
KRT8	keratin 8	3856
KRT18	keratin 18	3875
KAL1	Kallmann syndrome 1 sequence	3730
NELL1	NEL-like 1 (chicken)	4745
CTNNB1	catenin (cadherin-associated protein), beta 1, 88kDa	1499
MRPS11	mitochondrial ribosomal protein S11	64963
CLDN4	claudin 4	1364
WNT6	wingless-type MMTV integration site family, member 6	7475
ACTA2	actin, alpha 2, smooth muscle, aorta	59
MMP2	matrix metalloproteinase 2 (gelatinase A, 72kDa gelatinase, 72kDa)	4313
MMP14	matrix metalloproteinase 14 (membrane-inserted)	4323
MMP28	matrix metalloproteinase 28	79148

gene symbol	Th22-supernatant-induced transcription factors in keratinocytes	identifier
FOXC2	forkhead box C2 (MFX-1, mesenchyme forkhead 1)	2303
STAT1	signal transducer and activator of transcription 1, 91kDa	6772
TBX3	T-box 3	6926
TBX21	T-box 21	30009
NFATC1	nuclear factor of activated T-cells, cytoplasmic, calcineurin-dependent	4772
IRF1	interferon regulatory factor 1	3659
IRF3	interferon regulatory factor 3	3661
IRF7	interferon regulatory factor 7	3665
IRF9	interferon regulatory factor 9	10379
IKZF4	IKAROS family zinc finger 4 (Eos)	64375
SP140	SP140 nuclear body protein	11262
NFIX	nuclear factor I/X (CCAAT-binding transcription factor)	4784
NFIC	nuclear factor I/C (CCAAT-binding transcription factor)	4782
NEUROG3	neurogenin 3	50674



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HMGA1	high mobility group AT-hook 1	3159
NFE2L1	nuclear factor (erythroid-derived 2)-like 1	4779
SCML2	sex comb on midleg-like 2 (Drosophila)	10389
NEUROD2	neurogenic differentiation 2	4761
ETV7	ets variant gene 7 (TEL2 oncogene)	51513
ETV6	ets variant gene 6 (TEL oncogene)	2120
ATF3	activating transcription factor 3	467
POU5F1	POU class 5 homeobox 1	5460
POU3F3	POU class 3 homeobox 3	5455
TP73	tumor protein p73	7161
SOX1	SRY (sex determining region Y)-box 1	6656
SMARCA4	SWI/SNF related, matrix associated, actin dependent regulator of	6597
MSX1	msh homeobox 1	4487
NKX2-8	NK2 homeobox 8	26257
LBX1	ladybird homeobox 1	10660
TRIM22	tripartite motif-containing 22	10346
ZSCAN4	zinc finger and SCAN domain containing 4	201516
ZFYVE9	zinc finger, FYVE domain containing 9	9372
TLX2	T-cell leukemia homeobox 2	3196
NR5A1	nuclear receptor subfamily 5, group A, member 1	2516
USF1	upstream transcription factor 1	7391
AFF4	AF4/FMR2 family, member 4	27125
HOXA10	homeobox A10	3206
ERG	v-ets erythroblastosis virus E26 oncogene homolog (avian)	2078

gene symbol	Th22-supernatant-induced transcriptional regulators in ker.	identifier
SOCS3	suppressor of cytokine signaling 3	9021
TAF8	TAF8 RNA polymerase II, TATA box binding protein (TBP)-associa	129685
CXXC1	CXXC finger 1 (PHD domain)	30827
SEC14L2	SEC14-like 2 (S. cerevisiae)	23541
MED13	mediator complex subunit 13	9969
NFATC1	nuclear factor of activated T-cells, cytoplasmic, calcineurin-deper	4772
CTNNB1	catenin (cadherin-associated protein), beta 1, 88kDa	1499
CRTC1	CREB regulated transcription coactivator 1	23373
SMARCA4	SWI/SNF related, matrix associated, actin dependent regulator of	6597
FOXC2	forkhead box C2 (MFH-1, mesenchyme forkhead 1)	2303
NR5A1	nuclear receptor subfamily 5, group A, member 1	2516
CIITA	class II, major histocompatibility complex, transactivator	4261

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HMGA1	high mobility group AT-hook 1	3159
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gene symbol	Th22-supernatant-induced receptors in keratinocytes	identifier
FGFR3	fibroblast growth factor receptor 3	2261
FGFR1	fibroblast growth factor receptor 1	2260
IFNAR2	interferon (alpha, beta and omega) receptor 2	3455
IL3RA	interleukin 3 receptor, alpha (low affinity)	3563
IL7R	interleukin 7 receptor	3575
IL12RB2	interleukin 12 receptor, beta 2	3595
IL15RA	interleukin 15 receptor, alpha	3601
IL17RA	interleukin 17 receptor A	23765
IL17RC	interleukin 17 receptor C	84818
CXCR3	chemokine (C-X-C motif) receptor 3	2833
CX3CR1	chemokine (C-X3-C motif) receptor 1	1524
CMKLR1	chemokine-like receptor 1	1240
PTAFR	platelet-activating factor receptor	5724
TNFRSF14	tumor necrosis factor receptor superfamily, member 14 (herpesvir	8764
TLR3	toll-like receptor 3	7098
CD86	CD86 molecule	942
CD40	CD40 molecule, TNF receptor superfamily member 5	958
ICAM1	intercellular adhesion molecule 1	3383
CD274	CD274 molecule (PD-L1)	29126
CD49B	ITGA2 integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	3673
EPHA2	EPH receptor A2	1969
LRP4	low density lipoprotein receptor-related protein 4	4038
LRP3	low density lipoprotein receptor-related protein 3	4037
LRP1	low density lipoprotein-related protein 1 (alpha-2-macroglobulin receptor)	4035
LY75	lymphocyte antigen 75	4065
CLEC1B	C-type lectin domain family 1, member B	51266
SEMA4C	sema domain, immunoglobulin domain (Ig), transmembrane domain	54910
SCARF2	scavenger receptor class F, member 2	91179
SEMA3D	sema domain, immunoglobulin domain (Ig), short basic domain, s	223117
PTPRN	protein tyrosine phosphatase, receptor type, N	5798
TMPRSS4	transmembrane protease, serine 4	56649
GPR78	G protein-coupled receptor 78	27201
GPR109B	G protein-coupled receptor 109B	8843
LGR4	leucine-rich repeat-containing G protein-coupled receptor 4	55366
CHRNA2	cholinergic receptor, nicotinic, alpha 2 (neuronal)	1135

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AKAP13	A kinase (PRKA) anchor protein 13	11214
PDCD1LG2	programmed cell death 1 ligand 2	80380
PVRL2	poliovirus receptor-related 2 (herpesvirus entry mediator B)	5819
C5orf39	chromosome 5 open reading frame 39	389289
PVR	poliovirus receptor	5817
MED13	mediator complex subunit 13	9969
PLXNB1	plexin B1	5364
EDNRA	endothelin receptor type A	1909
OPRK1	opioid receptor, kappa 1	4986
NPVF	neuropeptide VF precursor	64111
GFRA4	GDNF family receptor alpha 4	64096
NPBWR1	neuropeptides B/W receptor 1	2831
HLA-G	major histocompatibility complex, class I, G	3135
HLA-F	major histocompatibility complex, class I, F	3134
HLA-E	major histocompatibility complex, class I, E	3133
HLA-B	major histocompatibility complex, class I, B	3106
HLA-DRB3	major histocompatibility complex, class II, DR beta 3	3125
HLA-DRA	major histocompatibility complex, class II, DR alpha	3122
HLA-DPA1	major histocompatibility complex, class II, DP alpha 1	3113
HLA-C	major histocompatibility complex, class I, C	3107
HLA-A	major histocompatibility complex, class I, A	3105

gene symbol	Th22-supernatant-induced catalytic genes in keratinocytes	identifier
INDO	indoleamine-pyrrole 2,3 dioxygenase	3620
JAK1	Janus kinase 1 (a protein tyrosine kinase)	3716
PRKD2	protein kinase D2	25865
PKN3	protein kinase N3	29941
PRKCZ	protein kinase C, zeta	5590
SMG1	PI-3-kinase-related kinase SMG-1	23049
HDAC10	histone deacetylase 10	83933
MAP4K2	mitogen-activated protein kinase kinase kinase 2	5871
MAP2K3	mitogen-activated protein kinase kinase 3	5606
MAP4K5	mitogen-activated protein kinase kinase kinase 5	11183
MAP3K14	mitogen-activated protein kinase kinase kinase 14	9020
ADAR	adenosine deaminase, RNA-specific	103
ADAMTSL4	ADAMTS-like 4	54507
SAMHD1	SAM domain and HD domain 1	25939
PFKL	phosphofructokinase, liver	5211

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PRPF19	PRP19/PSO4 pre-mRNA processing factor 19 homolog	27339
CEL	carboxyl ester lipase (bile salt-stimulated lipase)	1056
GBP1	guanylate binding protein 1, interferon-inducible, 67kDa	2633
GBP5	guanylate binding protein 5	115362
GNB2	guanine nucleotide binding protein (G protein), beta polypeptide 2	2783
GNAO1	G protein, alpha activating activity polypeptide O	2775
GBP2	guanylate binding protein 2, interferon-inducible	2634
IFI30	interferon, gamma-inducible protein 30	10437
RFWD2	ring finger and WD repeat domain 2	64326
UBE2L6	ubiquitin-conjugating enzyme E2L 6	9246
GCNT3	glucosaminyl (N-acetyl) transferase 3, mucin type	9245
DUOX1	dual oxidase 1	53905
FADS3	fatty acid desaturase 3	3995
CBR3	carbonyl reductase 3	874
GSTM4	glutathione S-transferase M4	2948
MAN1B1	mannosidase, alpha, class 1B, member 1	11253
RSAD2	radical S-adenosyl methionine domain containing 2	91543
TYMP	thymidine phosphorylase	1890
ERAP1	endoplasmic reticulum aminopeptidase 1	51752
CASP1	caspase 1, apoptosis-rel.cysteine peptidase (interleukin 1, beta, convertase)	834
CAPN3	calpain 3, (p94)	825
AKAP13	A kinase (PRKA) anchor protein 13	11214
SEPX1	selenoprotein X, 1	51734
SPPL2B	signal peptide peptidase-like 2B	56928
PIB5PA	phosphatidylinositol (4,5) bisphosphate 5-phosphatase, A	27124
PIK3AP1	phosphoinositide-3-kinase adaptor protein 1	118788
PARP12	poly (ADP-ribose) polymerase family, member 12	64761
ERAP2	endoplasmic reticulum aminopeptidase 2	64167
OAS3	2'-5'-oligoadenylate synthetase 3, 100kDa	4940
OAS2	2'-5'-oligoadenylate synthetase 2, 69/71kDa	4939
OAS1	2',5'-oligoadenylate synthetase 1, 40/46kDa	4938
FN3K	fructosamine 3 kinase	64122
DDX58	DEAD (Asp-Glu-Ala-Asp) box polypeptide 58	23586
STEAP4	STEAP family member 4	79689
PANK2	pantothenate kinase 2	80025
PTPRN	protein tyrosine phosphatase, receptor type, N	5798
PTEN	phosphatase and tensin homolog	5728
DLST	dihydrolipoamide S-succinyltransferase	1743

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SBF1	SET binding factor 1	6305
HSD3B2	hydroxy-delta-5-steroid dehydrogenase, 3 beta- and steroid delta-isomerase 2	3284
NNMT	nicotinamide N-methyltransferase	4837
TAPBP	TAP binding protein (tapasin)	6892
CFB	complement factor B	629
SYN1	synapsin I	6853
LINCR	likely ortholog of mouse lung-inducible Neutralized-related C3HC4 RING domain protein	93082
PARP14	poly (ADP-ribose) polymerase family, member 14	54625
NELL1	NEL-like 1 (chicken)	4745
CTRL	chymotrypsin-like	1506
CYP27B1	cytochrome P450, family 27, subfamily B, polypeptide 1	1594
PARP9	poly (ADP-ribose) polymerase family, member 9	83666
TMPRSS4	transmembrane protease, serine 4	56649
LOXL3	lysyl oxidase-like 3	84695
CHD8	chromodomain helicase DNA binding protein 8	57680
PPM2C	protein phosphatase 2C, magnesium-dependent, catalytic subunit	54704
PSMB9	proteasome (prosome, macropain) subunit, beta type, 9	5698
TENC1	tensin like C1 domain containing phosphatase (tensin 2)	23371
PSMB10	proteasome (prosome, macropain) subunit, beta type, 10	5699
PSMB8	proteasome (prosome, macropain) subunit, beta type, 8	5696
MYO9B	myosin IXB	4650
SGPP2	sphingosine-1-phosphate phosphatase 2	130367
ADC	arginine decarboxylase	113451
CSAD	cysteine sulfinic acid decarboxylase	51380
EHMT2	euchromatic histone-lysine N-methyltransferase 2	10919
HM13	histocompatibility (minor) 13	81502
NAV2	neuron navigator 2	89797
XRN1	5'-3' exoribonuclease 1	54464
DHX38	DEAH (Asp-Glu-Ala-His) box polypeptide 38	9785
ART3	ADP-ribosyltransferase 3	419
SOD2	superoxide dismutase 2, mitochondrial	6648
MAN2B1	mannosidase, alpha, class 2B, member 1	4125
MAN2C1	mannosidase, alpha, class 2C, member 1	4123
SSH1	slingshot homolog 1 (Drosophila)	54434
PRKDC	protein kinase, DNA-activated, catalytic polypeptide	5591
C1RL	complement component 1, r subcomponent-like	51279
SMARCA4	SWI/SNF related, matrix associated, actin dependent regulator of chromatin, subfamily a, member 4	6597
GLRX	glutaredoxin (thioltransferase)	2745

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NT5C3	5'-nucleotidase, cytosolic III	51251
CPT1B	carnitine palmitoyltransferase 1B (muscle)	1375
CPM	carboxypeptidase M	1368
OASL	2'-5'-oligoadenylate synthetase-like	8638
ARSI	arylsulfatase family, member I	340075
CP	ceruloplasmin (ferroxidase)	1356
REXO1	REX1, RNA exonuclease 1 homolog (S. cerevisiae)	57455
APOBEC3D	apolipoprotein B mRNA editing enzyme, catalytic polypeptide-like 3D	140564
MMEL1	membrane metallo-endopeptidase-like 1	79258
IKBKE	inhibitor of kappa light polypeptide gene enhancer in B-cells, kinase epsilon	9641
HERC5	hect domain and RLD 5	51191
CARD11	caspase recruitment domain family, member 11	84433
CDK10	cyclin-dependent kinase 10	8558
BCR	breakpoint cluster region	613
APOBEC3G	apolipoprotein B mRNA editing enzyme, catalytic polypeptide-like 3G	60489
AKT2	v-akt murine thymoma viral oncogene homolog 2	208
SETX	senataxin	23064
MOV10	Mov10, Moloney leukemia virus 10, homolog (mouse)	4343
WARS	tryptophanyl-tRNA synthetase	7453
CYCS	cytochrome c, somatic	54205
HSD3B1	hydroxy-delta-5-steroid dehydrogenase, 3 beta- and steroid delta-isomerase 1	3283
AEBP1	AE binding protein 1	165
CDC42BPA	CDC42 binding protein kinase alpha (DMPK-like)	8476
PLOD2	procollagen-lysine, 2-oxoglutarate 5-dioxygenase 2	5352
NARG1	NMDA receptor regulated 1	80155
SPG3A	spastic paraplegia 3A (autosomal dominant)	51062
EXOC4	exocyst complex component 4	60412
DDX17	DEAD (Asp-Glu-Ala-Asp) box polypeptide 17	10521
CKB	creatine kinase, brain	1152
UNQ1887	signal peptide peptidase 3	121665
ZC3HAV1	zinc finger CCCH-type, antiviral 1	56829
TRAF7	TNF receptor-associated factor 7	84231
EPHX1	epoxide hydrolase 1, microsomal (xenobiotic)	2052
ACE2	angiotensin I converting enzyme (peptidyl-dipeptidase A) 2	59272
UBE2B	ubiquitin-conjugating enzyme E2B (RAD6 homolog)	7320
UBA7	ubiquitin-like modifier activating enzyme 7	7318
ADAMTSL3	ADAMTS-like 3	57188
IFIH1	interferon induced with helicase C domain 1	64135

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ITPKC	inositol 1,4,5-trisphosphate 3-kinase C	80271
CTSB	cathepsin B	1508
GGT3P	gamma-glutamyltransferase 3 pseudogene	2679
CYP4F2	cytochrome P450, family 4, subfamily F, polypeptide 2	8529
HUWE1	HECT, UBA and WWE domain containing 1	10075
NAT1	N-acetyltransferase 1 (arylamine N-acetyltransferase)	9
RRAD	Ras-related associated with diabetes	6236

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gene symbol	Th22-supernatant-inhibited structural genes in keratinocytes	identifier
TPM1	tropomyosin 1 (alpha)	7168
EPB41L4B	erythrocyte membrane protein band 4.1 like 4B	54566
COPA	coatomer protein complex, subunit alpha	1314
CDC42SE2	CDC42 small effector 2	56990
CLDN12	claudin 12	9069
CLDN17	claudin 17	26285
NEFL	neurofilament, light polypeptide 68kDa	4747
ACTG2	actin, gamma 2, smooth muscle, enteric	72
ACTA1	actin, alpha 1, skeletal muscle	58
CTNNA3	catenin (cadherin-associated protein), alpha 3	29119
WNT4	wingless-type MMTV integration site family, member 4	54361
NPHP4	nephronophthisis 4	261734

gene symbol	Th22-supernatant-inhibited transcription factors in ker.	identifier
FOXO4	forkhead box O4	4303
ZNF140	zinc finger protein 140	7699
ZNF367	zinc finger protein 367	195828
RORA	RAR-related orphan receptor A	6095
ROR1	receptor tyrosine kinase-like orphan receptor 1	4919
TGIF2	TGFB-induced factor homeobox 2	60436
CREB5	cAMP responsive element binding protein 5	9586
BLZF1	basic leucine zipper nuclear factor 1	8548
ATF6	activating transcription factor 6	22926
BARX2	BARX homeobox 2	8538
EGR2	early growth response 2 (Krox-20 homolog, Drosophila)	1959
TRPS1	trichorhinophalangeal syndrome I	7227
TCF7L2	transcription factor 7-like 2 (T-cell specific, HMG-box)	6934
HEY1	hairy/enhancer-of-split related with YRPW motif 1	23462
HOXD10	homeobox D10	3236
KLF2	Kruppel-like factor 2 (lung)	10365
KLF12	Kruppel-like factor 12	11278
TFDP1	transcription factor Dp-1	7027
SRF	serum response factor (c-fos serum response element-binding transcription factor)	6722
TFDP3	transcription factor Dp family, member 3	51270
SOX4	SRY (sex determining region Y)-box 4	6659
CBFA2T3	core-binding factor, runt domain, alpha subunit 2; translocated to, 3	863



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gene symbol	Th22-specific, inhibited receptors	identifier
IL20RA	interleukin 20 receptor, alpha	53832
FGFR1	fibroblast growth factor receptor 1	2260
IL13RA1	interleukin 13 receptor, alpha 1	3597
BMPRI1A	bone morphogenetic protein receptor, type IA	657
ITGBL1	integrin, beta-like 1 (with EGF-like repeat domains)	9358
PTGER4	prostaglandin E receptor 4 (subtype EP4)	5734
GPR1	G protein-coupled receptor 1	2825
GPR110	G protein-coupled receptor 110	266977
FZD5	frizzled homolog 5 (Drosophila)	7855
TEK	TEK tyrosine kinase, endothelial	7010
PAQR8	progesterone and adipoQ receptor family member VIII	85315
SCUBE1	signal peptide, CUB domain, EGF-like 1	80274
LMBR1	limb region 1 homolog (mouse)	64327
HMMR	hyaluronan-mediated motility receptor (RHAMM)	3161
SLC20A1	solute carrier family 20 (phosphate transporter), member 1	6574
TRPM3	transient receptor potential cation channel, subfamily M, member 3	80036
APLNR	apelin receptor	187
TAPT1	transmembrane anterior posterior transformation 1	202018
PAQR3	progesterone and adipoQ receptor family member III	152559
GLRB	glycine receptor, beta	2743

gene symbol	Th22-supernatant-inhibited catalytic genes in Keratinocytes	identifier
PTGES3	prostaglandin E synthase 3 (cytosolic)	10728
PTGR2	prostaglandin reductase 2	145482
HSD17B12	hydroxysteroid (17-beta) dehydrogenase 12	51144
HPGD	hydroxyprostaglandin dehydrogenase 15-(NAD)	3248
PDE1A	phosphodiesterase 1A, calmodulin-dependent	5136
PPP1CB	protein phosphatase 1, catalytic subunit, beta isoform	5500
PPP2R5C	protein phosphatase 2, regulatory subunit B', gamma isoform	5527
PPP2CB	protein phosphatase 2 (formerly 2A), catalytic subunit, beta	5516
PSPH	phosphoserine phosphatase	5723
PLA2G7	phospholipase A2, group VII (platelet-activating factor	7941
PACSIN1	protein kinase C and casein kinase substrate in neurons 1	29993

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PRKCSH	protein kinase C substrate 80K-H	5589
PRKCH	protein kinase C, eta	5583
TTK	TTK protein kinase	7272
MAPK6	mitogen-activated protein kinase 6	5597
MAPK9	mitogen-activated protein kinase 9	5601
MAP2K5	mitogen-activated protein kinase kinase 5	5607
PLK1	polo-like kinase 1 (Drosophila)	5347
PKIB	protein kinase (cAMP-dependent, catalytic) inhibitor beta	5570
GNAZ	guanine nucleotide binding protein (G protein), alpha z polypeptide	2781
GNAQ	guanine nucleotide binding protein (G protein), q polypeptide	2776
RND2	Rho family GTPase 2	8153
RAB4A	RAB4A, member RAS oncogene family	5867
RAB28	RAB28, member RAS oncogene family	9364
RAB38	RAB38, member RAS oncogene family	23682
RHOT1	ras homolog gene family, member T1	55288
RAP1A	RAP1A, member of RAS oncogene family	5906
RAB1A	RAB1A, member RAS oncogene family	5861
ARL6IP2	ADP-ribosylation factor-like 6 interacting protein 2	64225
ATP5G3	ATP synthase, H <sup>+</sup> transporting, mitochondrial F0 complex, subunit C3 (subunit 9)	518
ATP11B	ATPase, class VI, type 11B	23200
ATP1B1	ATPase, Na <sup>+</sup> /K <sup>+</sup> transporting, beta 1 polypeptide	481
ABCB10	ATP-binding cassette, sub-family B (MDR/TAP), member 10	23456
UGCGL2	UDP-glucose ceramide glucosyltransferase-like 2	55757
UGT1A6	UDP glucuronosyltransferase 1 family, polypeptide A6	54578
DNMT3B	DNA (cytosine-5-)-methyltransferase 3 beta	1789
ITPK1	inositol 1,3,4-triphosphate 5/6 kinase	3705
PIGA	phosphatidylinositol glycan anchor biosynthesis, class A	5277
PIP5K1A	phosphatidylinositol-4-phosphate 5-kinase, type I, alpha	8394
PIGU	phosphatidylinositol glycan anchor biosynthesis, class U	128869
TEK	TEK tyrosine kinase, endothelial	7010
NEK1	NIMA (never in mitosis gene a)-related kinase 1	4750
NEK2	NIMA (never in mitosis gene a)-related kinase 2	4751
NEK4	NIMA (never in mitosis gene a)-related kinase 4	6787
NEK7	NIMA (never in mitosis gene a)-related kinase 7	140609
SNF1LK	SNF1-like kinase	150094
WNK1	WNK lysine deficient protein kinase 1	65125
MYLK	myosin light chain kinase	4638
ACOX2	acyl-Coenzyme A oxidase 2, branched chain	8309

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HMGCS1	3-hydroxy-3-methylglutaryl-Coenzyme A synthase 1 (soluble)	3157
ACADSB	acyl-Coenzyme A dehydrogenase, short/branched chain	36
ASAH1	N-acylsphingosine amidohydrolase (acid ceramidase) 1	427
SOAT1	sterol O-acyltransferase (acyl-Coenzyme A: cholesterol acyltransferase) 1	6646
ACOT12	acyl-CoA thioesterase 12	134526
SCD5	stearoyl-CoA desaturase 5	79966
NLN	neurolysin (metallopeptidase M3 family)	57486
AGPAT9	1-acylglycerol-3-phosphate O-acyltransferase 9	84803
ARIH1	ariadne homolog, ubiquitin-conjugating enzyme E2 binding protein, 1	25820
SEPHS1	selenophosphate synthetase 1	22929
OCRL	oculocerebrorenal syndrome of Lowe	4952
RAD54B	RAD54 homolog B ( <i>S. cerevisiae</i> )	25788
BCKDHB	branched chain keto acid dehydrogenase E1, beta polypeptide	594
NSF	N-ethylmaleimide-sensitive factor	4905
GCLC	glutamate-cysteine ligase, catalytic subunit	2729
OLAH	oleoyl-ACP hydrolase	55301
CRYZ	crystallin, zeta (quinone reductase)	1429
EXOSC6	exosome component 6	118460
NUDT19	nudix (nucleoside diphosphate linked moiety X)-type motif 19	390916
SCLY	selenocysteine lyase	51540
UEVLD	UEV and lactate/malate dehydrogenase domains	55293
GATM	glycine amidinotransferase (L-arginine:glycine amidinotransferase)	2628
GART	phosphoribosylglycinamide formyltransferase (...)	2618
ESCO2	establishment of cohesion 1 homolog 2 ( <i>S. cerevisiae</i> )	157570
KIF20B	kinesin family member 20B	9585
LOXL1	lysyl oxidase-like 1	4016
LMO7	LIM domain 7	4008
AKTIP	AKT interacting protein	64400
TRIM23	tripartite motif-containing 23	373
DPYSL2	dihydropyrimidinase-like 2	1808
LGALS13	lectin, galactoside-binding, soluble, 13	29124
YES1	v-yes-1 Yamaguchi sarcoma viral oncogene homolog 1	7525
CDKN3	cyclin-dependent kinase inhibitor 3	1033
LFNG	LFNG O-fucosylpeptide 3-beta-N-acetylglucosaminyltransferase	3955
BCAT1	branched chain aminotransferase 1, cytosolic	586
RNF144B	ring finger 144B	255488
SQLE	squalene epoxidase	6713
ST3GAL5	ST3 beta-galactoside alpha-2,3-sialyltransferase 5	8869

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RFC3	replication factor C (activator 1) 3, 38kDa	5983
GBE1	glucan (1,4-alpha-), branching enzyme 1	2632
AKR1B10	aldo-keto reductase family 1, member B10 (aldose reductase)	57016
PGM3	phosphoglucomutase 3	5238
ERCC6L	excision repair cross-complementing rodent repair deficiency	54821
HCCS	holocytochrome c synthase (cytochrome c heme-lyase)	3052
MMEL1	membrane metallo-endopeptidase-like 1	79258
GPAM	glycerol-3-phosphate acyltransferase, mitochondrial	57678
CTDSPL	CTD (carboxy-terminal domain, RNA polymerase II, polypeptide A) phosphatase-like	10217
SMPD3	sphingomyelin phosphodiesterase 3, neutral membrane (neutral sphingomyelinase II)	55512
CYP3A4	cytochrome P450, family 3, subfamily A, polypeptide 4	1576
DHDDS	dehydrodolichyl diphosphate synthase	79947
ADAM9	ADAM metallopeptidase domain 9 (meltrin gamma)	8754
XRCC6BP1	XRCC6 binding protein 1	91419
ELOVL6	ELOVL family member 6, elongation of long chain fatty acids (FEN1/Elo2, SUR4/Elo3-like, yeast)	79071
PCSK5	proprotein convertase subtilisin/kexin type 5	5125
HTRA1	HtrA serine peptidase 1	5654
SUV420H1	suppressor of variegation 4-20 homolog 1 (Drosophila)	51111
CPOX	coproporphyrinogen oxidase	1371
CROT	carnitine O-octanoyltransferase	54677
USP9Y	ubiquitin specific peptidase 9, Y-linked (fat facets-like, Drosophila)	8287
UBE2E1	ubiquitin-conjugating enzyme E2E 1 (UBC4/5 homolog, yeast)	7324
UBA3	ubiquitin-like modifier activating enzyme 3	9039
UBE2C	ubiquitin-conjugating enzyme E2C	11065
HPGD	hydroxyprostaglandin dehydrogenase 15-(NAD)	3248