

Syngene

Putting Science to Work

List of validated animal models

In Vivo Pharmacology



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Oncology

Tumor type	Cell line
Cell line derived subcutaneous xenograft models in mouse (*+Orthotopic)	
Acute Myeloid Leukemia (AML)	KG-1
	MV4-11
	Kasumi-3
Angiosarcoma	SVR
Brain	U87-MG*
	U251
Breast	MCF-7
	MDA-MB-231*
	HCC70
	T47D
	MDA-MB-468
Bladder	T24*
	5637
	TCCSUP
	UMC-1*
	UMC-14*
	KMBC-2
	RT-112 (orthotopic)
Burkitt's lymphoma	RAJI
Chronic Myeloid Leukemia (CML)	K562 (Disseminated)
Colon	HCT116*
	DLD1
	SW480
	HT29*
	COLO-205
Epidermoid (Skin)	A431
Gastric	N-87
Head & Neck	CAL-27
	HEp-2
Lung	A549*
	H1975
	NCI-H460
	NCI-H441
	NCI-H23
	NCI-H727
	NCI-H1373
	NCI-H358
	NCI-H82
	PC-9*

Tumor type	Cell line
Liver	HepG2
	SNU-398
	JHH-7
Kidney	ACHN
Melanoma	A375
Multiple Myeloma	NCI-H929
Medulloblastoma	D283
Ovarian	SKOV-3
	PA-1
	OVCAR-3
	OVCAR-5
	OV-90
Osteosarcoma	SJSA-1
Pancreas	BX-PC3*
	MIA PaCa-2*
	AsPC-1
Prostate	LNCaP
	VCap
	22Rv1
	DU145
Pro-B cell line	Ba/F3
Retinoblastoma	Y79
	NCC-RbC-51
Patient derived subcutaneous xenograft models in mouse	
Head & Neck	Patient-derived tumors
Cell line derived syngeneic models in mouse (*+Orthotopic)	
Breast	4T1*
	EMT6*
	E3*
Bladder	NBT-II* (Rat Model)
Colon	CT-26
	MC-38
Lung	LLC
Melanoma	B16F10
Humanized mouse subcutaneous model	
Prostate	PC-3

Tumor type	Cell line
Adoptive T cell transfer & PBMC engrafted models in mouse	
Colon	MC-38 (hCCR2 KI mice)
	MC-38 (in B-h4-1BB mice)
	DLD1
	COLO-205
Lung	SHP-77
Liver	HepG2
Multiple Myeloma	NCI-H929
Ovarian	OVCAR-3
3D Spheroid subcutaneous model in mouse	
Melanoma	B16F10
IVIS Bio-imaging	
Bioluminescence	Biodistribution of cells/test item tagged with Luciferase
	Cell lines: 4T1-Luc, RT112-Luc, OVCAR3-Luc, NCI-H929-FLuc
Fluorescence	Biodistribution of labelled test item or cells (RFP/GFP/AF647)
	Probing growth of orthotopic tumor cells expressing mCherry protein (U251-mCherry)
Biodistribution of mammalian cells or antibodies injected in mice can be assessed by <i>In vivo</i> imaging to assess disease development in animals. Test item/antibodies tagged with fluorescence or luminescence probes support the organ/tissue specificity as well as the kinetics in animals.	

Metabolic Disease

Disease	Animal model	Test Species
Diabetes and Obesity	Genetic: <i>db/db</i> and <i>ob/ob</i>	Mice
	Diet Induced Obesity (DIO)	Mice
	Insulin sensitivity models: ITT, OGTT and IPGTT	Rat
	STZ induced type 1 diabetes	Rats
	Zucker Obese, <i>ZDF</i>	Rat
Diabetes complications	Diabetic neuropathy: STZ induced diabetic neuropathy	Rat
	Diabetic nephropathy: STZ induced diabetic nephropathy	Rat
	Diabetic retinopathy: <i>ZDF</i> model and STZ induced diabetic retinopathy	Rat
	Excisional- <i>db/db</i> , Doxorubicin induced delayed wound healing; Incisional and burn wound healing	Mice & Rat
Germfree mice capabilities	D-Galactose induced ageing in Germfree mice	Mice
	Colorectal cancer development in <i>APC^{min/+}</i> mice using pks+ <i>E. coli</i>	Mice
Humanized liver	TK-NOG humanized liver model for efficacy and PK	Mice
Non-alcoholic steatohepatitis (NASH)	MCD diet model	Mice
	STZ + HFD induced NASH	Mice
	Syngene NASH	Mice
	Ultrafast NASH (UF-NASH)	Mice
Others	Bile acid modulations: C57BL/6, OATP KO and Bile duct ligation (BDL)	Mice & Rat

Cardiovascular disorders

Disease	Animal model	Test Species
Arterial thrombosis	FeCl ₃ induced rat model of arterial thrombosis	Rat
Atherosclerosis	<i>LDLr</i> KO mice and <i>ApoE</i> KO mice	Mice
Cardiomyopathy	<i>ZDF</i> , High fat diet and STZ and <i>db/db</i> mice	Rat, Mice
Dyslipidemia	High fat diet induced dyslipidemia	Guinea pig and Hamster
Hypertension	DOCA salt induced Hypertension	Rat, Mice
Myocardial Infarction (MI)	Isoproterenol induced acute myocardial infarction	Rat
	Left anterior descending artery (LAD) ligation induced MI	Rat
Portal hypertension	Bile duct ligation (BDL) induced portal hypertension	Rat
	Carbon tetrachloride (CCL ₄) induced portal hypertension	Rat
Venous diseases	Critical limb ischemia	Mice
Validated techniques	Carotid artery and Jugular vein cannulation	Rat
	Electrocardiogram (ECG)	Rat, Mice
	Femoral artery ligation	Rat
	Hemodynamic parameters by Miller probe	Rat
	Invasive blood pressure (IBP) recording by pressure transducer	Rat
	Isolated Heart experiment - Langendorff apparatus	Rat, Rabbits
	LAD Coronary artery ligation and reperfusion	Rat
	Non-Invasive Blood Pressure (NIBP)	Rat, Mice
	Renal artery ligation	Rat

Inflammation & Immunology

Disease	Animal model	Test Species
Acute Inflammation	Air pouch inflammation	Mice
	Anti-CD3 induced oral inflammation	Mice PD Model
	Carrageenan induced paw edema	Mice
	ConA induced acute hepatitis	Mice
	Hypersensitivity: mBSA, KLH, oxazolone induced DTH model	Rat and mice
	IL-12 induced IFN-gamma release	Mice
	LPS induced pulmonary inflammation	Mice
	LPS induced systemic inflammation	Mice
	MOG/Ovalbumin induced cytokine release & cell proliferation	Mice
	TGF- β induced acute pulmonary injury	Mice
	Thioglycolate induced peritoneal inflammation	Mice
	Zymosan induced peritoneal inflammation	Mice
	Zymosan induced pulmonary inflammation	Rat and mice
Acne	Hamster model of sebaceous gland hypertrophy	Hamster
Arthritis	Adjuvant induced arthritis	Rat
	Collagen antibody induced arthritis	Mice
	Collagen induced arthritis	Rat and Mice
	Medial meniscal tear osteoarthritis	Rat
	MIA induced osteoarthritis	Rat
Dermatitis	Oxazolone Induced dermatitis	Mice
	TPA induced chronic inflammation/ epidermal hyperplasia	Mice
Humanized Mouse	Oxazolone induced dermatitis in huNOG-Ex1 mice	Mice
IBD	DSS induced acute and chronic colitis	Mice
	Oxazolone induced colitis	Mice
	TNBS colitis	Mice
Itch	Chloroquine induced itch	Mice
Multiple Sclerosis	MOG ₃₅₋₅₅ induced chronic EAE	Mice
	PLP ₁₃₁₋₁₅₅ induced adoptive transfer EAE	Mice
	PLP ₁₃₁₋₁₅₅ induced relapse-remitting EAE	Mice
Psoriasis	IL-23 induced	Mice
	Imiquimod induced	Mice
	TPA induced acute inflammation	Mice
Sepsis	Cecal ligation and puncture induced sepsis and acute kidney injury	Mice
	LPS induced sepsis and acute kidney injury	Mice
Systemic Lupus Nephritis	MRL lpr model of lupus nephritis	Mice

Pain Pharmacology

Disease	Animal model	Test Species
Complex regional pain syndrome -1 (CRPS-1)	Chronic post ischemia pain (CPIP)	Mice, Rat
Cystitis	Cyclophosphamide induced cystitis	Rat
	Ketamine induced cystitis	Rat
Inflammatory pain	Carrageenan induced hyperalgesia	Rat
	CFA induced inflammatory pain	Rat
	Zymosan induced inflammatory pain	Rat
Neuropathic pain	Chronic Constriction Injury (CCI)	Mice, Rat
	Cisplatin induced neuropathic pain	Rat
	Partial Sciatic Nerve Ligation (PSNL)	Mice, Rat
	Spared Nerve Injury (SNI)	Rat, Mice
	Spinal Nerve Ligation (SNL)	Mice, Rat
	STZ induced diabetic neuropathy	Rat
Nociceptive pain	Capsaicin induced primary and secondary hyperalgesia	Mice
	Formalin induced pain	Mice
	Hot plate	Mice
	Tail flick	Rat
	Visceral (acetic acid induced writhing)	Mice
Post-operative pain	Incision pain (Brennan) model	Rat, Mice

Neuroscience

Disease	Animal model	Test Species
Amyotrophic Lateral Sclerosis	Transgenic model - SOD1 G93A mice	Mice
Anxiety and Exploratory Behavior	Behavioral assessment	Rat, mice
Acute and Chronic Stress	Chronic unpredictable stress; Chronic immobilization/restraint stress; Acute and chronic ACTH induced corticosterone release; Bilateral adrenalectomy model	Rat and/or Mice
Cerebral Ischemia	MCA occlusion induced cerebral ischemia	Rat
Cognition-Alzheimer's	Scopolamine induced amnesia	Rat
Conditioned Taste Aversion	Sucrose consumption	Mice
Depression, Aggression	Behavioral assessment	Rat, mice
Epilepsy	Epilepsy screening model - PTZ induced seizures	Mice
Huntington's Disease	Transgenic model - R6/2 mice	Mice
Neuroinflammation	LPS induced inflammation – CNS vs Peripheral	Mice
Parkinson's Disease	6-OHDA; Rotenone; MPTP-induced PD	Rat or Mice
Sleep, Circadian Rhythm studies	Non-invasive activity measurement	Rat, mice

Activity	Technique/Test	Test Species
Brain Biodistribution	Intra-parenchymal (various brain regions) Intracerebroventricular (ICV); Intra cisterna magna (ICM); Intrathecal & Intranasal	Mice and Rat
Behavioral Assessment	Balance beam test	Rat, Mice
	Cylinder test	Rats
	Elevated plus maze	Rat, Mice
	Grip strength	Rat, Mice
	Inverted screen test	Mice
	Marble burying Test	Mice
	Morris water maze	Rat
	Novel object recognition test	Rat, Mice
	Novelty suppressed feeding	Rat, Mice
	Open field assessment	Rat, Mice
	Porsolt's forced swimming test	Rat, Mice
	Rotarod test	Rat, Mice
	Social interaction and sociability	Mice
	Tail suspension	Mice

Fibrotic disorders

Disease	Animal model	Test Species
Kidney Fibrosis	Folic acid induced renal fibrosis	Mice
	Unilateral Ureter Obstruction (UUO)	Mice, Rat
Liver Fibrosis	CCL ₄ induced Liver fibrosis	Mice, Rat
	Bile duct ligation induced liver fibrosis	Mice, Rat
	TAA induced liver fibrosis	Mice, Rat
Lung Fibrosis	Bleomycin- Pulmonary Inflammation and fibrosis	Mice
Vertebral Fibrosis	Laminectomy induced vertebral fibrosis	Rat

Pulmonology: List of validated models

Allergic Asthma	Ovalbumin induced allergic airway inflammation	Mice
Bronchoconstriction	Acetylcholine induced airway hyperresponsiveness	Guinea pigs
Lung Function in BLM Fibrosis	Bleomycin induced airway functional changes	Mice
Local Delivery	Inhalation, Oral Aspiration, Intra-Tracheal & Intra-Nasal	Mice & Rat

Systemic Models

Disease	Animal model	Test Species
Gastrointestinal Pharmacology		
Constipation	Loperamide induced	Rat
Diarrhea	Bile acid induced	Rat
	Ceectomy	Rat
	Cholera toxin induced jejunum segment model	Mice
Gastric Motility	Charcoal meal test	Rat
Ulcer	Diclofenac induced	Rat
	Ethanol induced	Rat
	Indomethacin induced	Rat
Musculoskeletal System		
Cachexia	Dexamethasone induced	Rats
Muscle fatigue	Muscle fatigue assessment of various treatments - rats	Rat
NMB	Reversal of neuromuscular blockage (NMB)	Rat and guinea pigs
Ophthalmology		
Uveitis	Autoimmune uveitis	Rats
	LPS induced uveitis	Rabbits
Glaucoma	Glaucoma studies	Rabbits
	Intravitreal and topical ocular tissue biodistribution	Rats, Rabbits
	Tear secretion studies	Rabbits
	Optic neuritis	Rat
Pulmonary Models		
Airway hyperresponsiveness	Acetylcholine induced airway hyperresponsiveness model – Acute bronchoconstriction assay	Rat, Mice, Guinea pig
Asthma	Ovalbumin induced asthma	Mice
Renal Pharmacology		
Acute kidney injury	Cisplatin AKI	Rat or Mice
	Glycerol induced AKI	Rat
	Ischemia reperfusion acute kidney injury	Rat
Chronic kidney disease (CKD)	DOCA salt induced nephropathy	Mice
	STZ induced nephropathy	Rats
	Adenine induced CKD	Rats
LPS induced nephritis	LPS induced nephritis	Mice
Others	mGFR – Glomerular filtration rate	Rat and Mice

Ex vivo Assays for *In vivo* Pharmacology: Few examples of validated markers

Assay Type	Model / Disease Condition	Biomarkers Assessed E.g.,
Colorimetric Assays	BLM Fibrosis, NASH, Liver fibrosis	Cattle Blood: BUN, BHB, Progesterone, Glucose, NEFA and Cortisol
		Hydroxyproline, TGF- β and soluble collagen, Total Bile acid, MPO assay
ELISA	Chronic stress, DSS colitis, Endotoxin induced Uveitis LPS endotoxemia, Oxazolone dermatitis, ZDF rats	IL-23, IL-10 and TNF-alpha, KIM-1, Cystatin-C, LDH, CK-18, GST-alpha, NGAL and Cystatin-C, Insulin ELISA, EPHA2, GSH, MDA, Cardiac troponin I, NT-proBNP, c-peptide, Albumin, Hs-CRP, Corticosterone, ACTH, IL-1beta, IL-6 and IL-33
Gene expression by qRT-PCR	BLM induced pulmonary fibrosis	Snai1, TGF- β 1, CXCL10, Col1a1
	Brain distribution study in mice	Arc, BDNF, c-fos, Gria-1, Gria-2 and Egr-1
	CCL ₄ induced liver fibrosis	COL1 α , MCP-1, IL-1 β & α SMA
	DSS Colitis	IL-9, IL-10 and IL-1beta
	NASH	α -SMA, MCP-1, Col1a1, IL1 β , GRIFFIN, Fasn, Acaca, BIM, PUMA
Luminex xMAP platform	CIA, DSS, TNBS Colitis, LPS inflammation, Xenograft models, ASO toxicity, Arthritis, Dermatitis, CD3 inflammation and Diabetes	32-plex cytokine analysis:
		IL-1beta, IL-2, IL-4, IL-5, IL-6, IL-12(P40), IL-12(P70), IL-17, KC, MCP-1, MIP-2, TNF-Alpha, IL-10
Flow cytometry	TNP-KLH (Follicular Helper T-cells), huNOG EXL (TILs)	GL7, BCL6, CXCR5, PD1, CD3, CD4, CD45, B220, Activated CD4,CD8, Tregs (CD4+ CD25+ FoxP3+), NK (CD56+dim CD16+) Monocytes (CD11b+)
Western blot analysis	BaF3 EGFR – Tumor xenograft	pEGFR, pAKT, pERK, total AKT, ERK and tEGFR
	BLM induced pulmonary fibrosis	pSMAD2/3, pMYPT1, tSMAD2/3 & tMYPT1
	Diabetes	PPAR- α , PGC-1 α , pAMPK and total AMPK
	Murine OVCAR-3 xenograft	pRB and total RB
	NASH	Acetylated tubulin

Histopathology and Immunohistochemistry: Few examples of validated markers

Special Staining	
Markers/Target	Type of staining
Amyloid and Eosinophil in tissue sections	Congo Red
Crypt architecture	Methylene Blue
Collagen	Sirius red, Masson's Trichrome
Glycogen	PAS (Periodic Acid Schiff)
Lipids and neutral Triglycerides	Oil red O
Mast cell and Cartilage	Toluidine Blue
Myelin/Myelinated axon	Luxol Fast Blue, Bielchowsky Silver Stain
Immunohistochemistry- Validated markers	
Acute-Kidney Injury	NGAL, KIM1, VDAC1, CD38
Angiogenesis/Endothelial	CD31, CD105, VEGF, MECA79
Apoptotic markers	TUNEL, Caspase 3, Cleaved Caspase 3
Arthritis model	MMP13, CDKN2A, SOX-9, USP16, GFP, HMGB1, IL1 β
Cancer biomarkers	CDH17, CEACAM18, CDH16, CLDN6, MUC16, FOLR1, ENPP3, B7H3
Diabetes	Insulin, Glucagon
DNA Damage	γ -H2AX, 8-OH dG
Fibrosis	α SMA
Immunological	T cell (CD3, CD4, CD8, FoxP3, CD25)
	B cell (CD20, CD19, B220, BCL6)
	NK cells (CD56, CD16), MDSC (CD33), NKG2D
	Macrophages, Dendritic cells (CD21/35, CD11b+, CD68, CD11C+, F4/80)
Neurological	TH, GFAP, Aqp 4, NeuN, MAP, IBA1, OLIG2, Synaptophysin
Proliferation markers	Ki67
Xenograft model	PERK, pAKT, ER, PR, HER1, HER2, E-Cadherin, EpCAM, p63, TGF- β , ERK1/2, 5T4
Dual staining	HRP + AP: CD3 + CD19; CD19 + BCL6; Insulin + Glucagon



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About Syngene

Syngene International Ltd. (BSE: 539268, NSE: SYNGENE, ISIN: INE398R01022) is an integrated research, development, and manufacturing services company serving the global pharmaceutical, biotechnology, nutrition, animal health, consumer goods, and specialty chemical sectors. Syngene's more than 6000 scientists offer both skills and the capacity to deliver great science, robust data security, and quality manufacturing, at speed, to improve time-to-market and lower the cost of innovation. With a combination of dedicated research facilities for Amgen, Baxter, and Bristol-Myers Squibb as well as 2.2 Mn sq. ft of specialist discovery, development and manufacturing facilities, Syngene works with biotech companies pursuing leading-edge science as well as multinationals, including GSK, Zoetis and Merck KGaA.