Light up neural differentiation pathways

Antibodies for pluripotent stem cells and neural lineage cells.

Stem cells have tremendous potential for use in developmental biology research, disease modeling, drug screening, and cell therapy for neurodegenerative disorders, including Alzheimer's and Parkinson's diseases. Stem cells are undifferentiated cells that have the capacity both to self-renew through mitosis and to differentiate into specialized cell types such as neuronal, liver, or muscle cells. Embryonic stem cells (ESCs) and induced pluripotent stem cells (iPSCs) are pluripotent stem cells (PSCs) that are commonly characterized by their expression of the transcription factors Nanog, OCT4, and SOX2, and the cell-surface proteins SSEA3, SSEA4, TRA-1-60, and TRA-1-81 (Figure 1). To verify the functional pluripotency of PSCs, they must undergo further testing to confirm their ability to differentiate into the three embryonic germ layers: ectoderm, mesoderm, and endoderm (also see page 31).

Mammalian neurogenesis begins with the induction of neuroectoderm, which forms the neural plate and then folds to give rise to the neural tube. These structures are composed of a layer of neuroepithelial progenitors (NEPs) that can be rapidly turned into primitive neural stem cells (NSCs). NSCs are self-renewing, multipotent progenitors present in the developing and adult mammalian central nervous system. During neural differentiation, NSCs undergo progressive lineage restrictions leading to glial progenitors (CD44$^+$ A2B5$^+$), which can become astrocytes (GFAP$^+$) and oligodendrocytes (Galc$^+$ O4$^+$). The other branch of lineage restriction is the neuronal path leading to various types of neurons such as dopaminergic (DA) neurons (Figure 2). Table 1 provides a list of common markers and the corresponding antibodies used to characterize PSCs and NSCs (Figure 1) as well as downstream glial and neuronal cells (Figure 2).

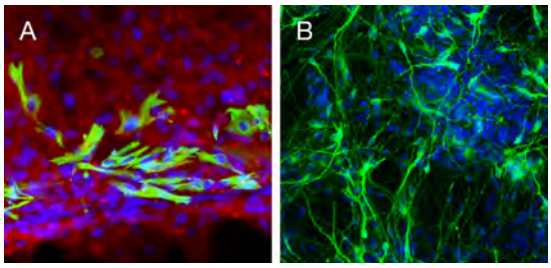

Figure 2. Characterization of astrocytes and dopaminergic (DA) neurons derived from PSCs. (A) Immunofluorescence staining of glial progenitors and astrocytes generated from PD-3 iPSC-derived neural stem cells using anti-GFAP (Cat. No. 180063) followed by Alexa Fluor™ 488 goat anti–rabbit IgG (green, Cat. No. A11034) antibodies and anti-CD44 followed by Alexa Fluor™ 594 goat anti–mouse IgG (red, Cat. No. A11005) antibodies. **(B)** Immunofluorescence staining of DA neurons derived from PSCs using anti–tyrosine hydroxylase (Cat. No. P21962) followed by Alexa Fluor™ 488 donkey anti–rabbit IgG (green, Cat. No. A21206) antibodies. Nuclear DNA was counterstained with DAPI (blue, Cat. No. P1306).

Find your stem cell antibody

The characterization of stem cells is a critical step in stem cell research. No matter which detection platform you use—flow cytometry, immunocytochemistry, western blot, ELISA, or another—our collection of over 51,000 Invitrogen™ antibodies provides you with tools compatible with your experimental design. Select the right antibodies for your stem cell targets at thermofisher.com/antibodiesbp74. ■

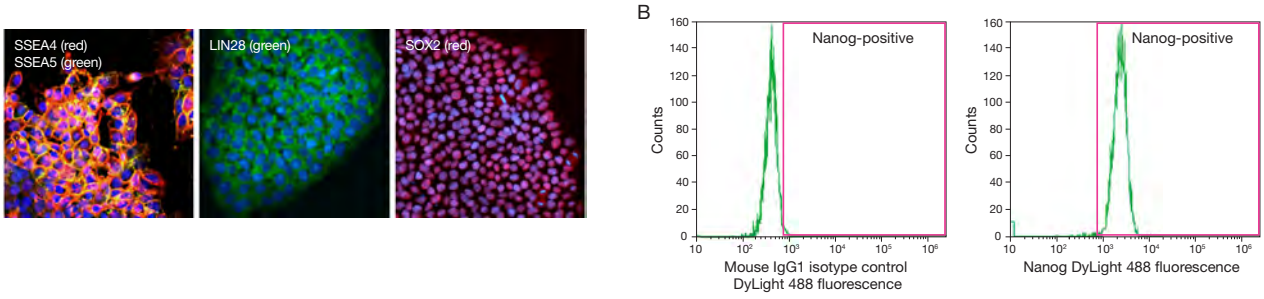

Figure 1. Characterization of human induced pluripotent stem cells. Gibco™ Human Episomal iPSCs (Cat. No. A18945) grown with Gibco™ Vitronectin (VTN-N) Recombinant Human Protein (Cat. No. A14700) in Gibco™ Essential 8™ Flex Medium (Cat. No. A2858501) were stained with the indicated Thermo Scientific™ DyLight™ dye–conjugated primary antibodies and analyzed by imaging or flow cytometry. **(A)** Immunofluorescence imaging of iPSCs counterstained with DAPI nuclear stain (blue, Cat. No. D1306). Left panel: DyLight 488 anti-SSEA5 mouse monoclonal antibody (green, Cat. No. MA1-144-D488) and DyLight 650 anti-SSEA4 mouse monoclonal antibody (red, Cat. No. MA1-021-D650). Middle panel: DyLight 488 anti-LIN28 mouse monoclonal antibody (green, Cat. No. MA1-016-D488). Right panel: DyLight 650 anti-SOX2 mouse monoclonal antibody (red, Cat. No. MA1-014-D650). **(B)** Histograms of iPSCs analyzed by flow cytometry. Left panel: DyLight 488 mouse IgG1 isotype control antibody (Cat. No. MA1-191-D488). Right panel: DyLight 488 anti-Nanog mouse monoclonal antibody (Cat. No. MA1-017-D488).

Table 1. Selected antibodies for the characterization of stem cells and neural lineage cells. For a complete list, go to thermofisher.com/antibodies.

	Target	Antibody Cat. No. (Clone ID)
Characterization of pluripotent stem cells		
Pluripotent stem cells	DNMT3B	PA1-884, 49-1028
	KLF4	710659 (1HCLC), PA1-095
	LIN28	MA1-016 (14E6-4E6), MA1-016-D488 (14E6-4E6), MA1-016-D550 (14E6-4E6), MA1-016-D650 (14E6-4E6), PA1-096
	NANOG	MA1-017 (23D2-3C6), MA1-017-D488 (23D2-3C6), MA1-017-D550 (23D2-3C6), MA1-017-D650 (23D2-3C6), PA1-097
	OCT4/POU5F1	A13998 (C30A3), MA1-104 (9B7), MA1-104-D488 (9B7), MA1-104-HRP (9B7), A18525 (EM92)
	PRDM14	PA1-114
	SALL4	720030
	SOX2	48-1400 (20G5), MA1-014 (20G5), MA1-014-D488 (20G5), MA1-014-D550 (20G5), MA1-014-D650 (20G5), PA1094
	SSEA1/CD15	MA1-022 (MC-480), MA1-022-D488 (MC-480), MA1-022-D550 (MC-480), MA1-022-D650 (MC-480), MA1-022-PE (MC-480), 18-0122 (MY-1), 41-1200
	SSEA3	41-4400 (MC-631), MA1-020 (MC-631), MA1-020-D488 (MC-631), MA1-020-D650 (MC-631), MA1-020-PE (MC-631)
	SSEA4	MA1-021 (MC813-70), MA1-021-D488 (MC813-70), MA1-021-D550 (MC813-70), MA1-021-D650 (MC813-70), MA1-021-PE (MC813-70)
	SSEA5	MA1-144 (8E11), MA1-144-D488 (8E11), MA1-144-D550, MA1-144-D650 (8E11), MA1-144-D755 (8E11), MA1-144-PE (8E11)
	TRA-1-60	411000 (cl.A), MA1-023 (tra-1-60), MA1-023-D488X (tra-1-60), MA1-023-D550 (tra-1-60), MA1-023-D650 (tra-1-60)
	TRA-1-81	411100 (cl.26), MA1-024 (tra-1-81), MA1-024-D488 (tra-1-81), MA1-024-D550 (tra-1-81), MA1-024-D650 (tra-1-81)
Germ layer mesendoderm	Brachyury (T)	MA5-17185 (1H9A2), PA5-23405
	EOMES	PA5-12261, MA5-24291 (644730)
	GSC	MA5-23070 (1C2), PA5-28380
	MIXL1	PA5-40323
Germ layer mesoderm	ABCA4	P21933 (3F4)
	NKX2.5	701622 (4H5L9), 710634 (4HCLC)
	PDGFRα	701142 (7H13L1), 710169 (7HCLC), PA516571, PA516742
	Smooth muscle actin	MA5-11544 (1A4 (asm-1)), PA5-16697, 701457 (17H19L35), 710487 (17HCLC), MA1-744 (mAbGEa)
Germ layer endoderm	α-Fetoprotein (AFP)	710486 (9HCLC), 18-0003 (ZSA06), MA5-12754 (C3), MA5-14665 (F1-6P2A8-P2B9A9), MA5-14666 (P5B8), PA5-16658
	FOXA1	MA1-091 (3A8)
	FOXA2	701698 (9H5L7), 710730 (9HCLC), MA5-15542 (7H4B7), 720061, A16568
	GATA4	PA1-102
	GATA6	PA1-104
	KLF5	42-3200
	SOX17	PA5-23352, PA5-23382
Germ layer ectoderm	β-III Tubulin	MA1-118 (2G10)
	PAX6	42-6600, MA1-109 (13B10-1A10)
	SOX1	PA5-23351, PA5-23370
Characterization of neural stem cells		
Neural stem cells	Nestin	MA1-110 (10C2)
	PAX6	42-6600, MA1-109 (13B10-1A10)
	SOX1	PA5-23351, PA5-23370
	SOX2	48-1400 (20G5), MA1-014 (20G5), MA1-014-D488, MA1-014-D550, MA1-014-D650, MA1-014-HRP, PA1-094
Neural differentiation and characterization of glial and neuronal cells		
Astrocytes	GFAP	13-0300 (2.2B10), MA5-12023 (ASTRO6), PA5-16291, A21282 (131-1771), A21294, A21295
	Glutamine synthetase	710963 (7HCLC)
	S100b	701340 (16H24L21), 710363 (16HCLC)
Cholinergic neurons	ChAT	PA1-4710, PA1-4738, PA1-9027, PA1-18313, PA5-29653
DA progenitor/ DA neurons	LMX1A	710980 (20HCLC)
	Nurr1	MA1-195 (N1404), PA1-4519, PA5-13416
	OTX2	701948 (14H14L5), MA5-15854 (1H12C4B5), MA5-15855 (1H12G8B2), PA5-23406, PA5-29914
	PITX3	701181 (5H10L5), 710212 (7M5HCLC), 38-2850
	Tyrosine hydroxylase	P21962, 701949, 710982