AXOL

"iPSCs? What can we do to help?"

Building better human disease models

At Axol Bioscience, we're here to support drug discovery researchers looking to utilize the power of iPSC-derived models.

Like you, we believe that these more human-relevant advanced *in vitro* models have the potential to unlock better, safer therapies for neurodegenerative and cardiovascular diseases.

We've been working with iPSCs in a quality-focused environment for over a decade and have developed a deep understanding of the challenges of this space. Whether it's compound screening on physiologically useful models, iPSC creation, QC and banking, or the large-scale supply of functionally relevant cells, we can help you.

What can you get when outsourcing to Axol?

- High-quality, functionally consistent **axoCells™**
- A bank of over 70 fully characterized and licensed **axoLines™**
- Our QC-rich suite of **axoServices™,** technical iPSC projects
- Cellular assays including multi-electrode array (MEA), 'omics and real-time imaging
- Building iPSC-based **axoModels™** for compound screening

Collaboration is one of our six core company values; we're here to help you by doing the heavy lifting so you can focus on the science with reduced risk, shortened project timelines and improved outcomes.

If you're also a believer in the potential of iPSCs, let's talk.

Duncan Borthwick PhD
Head of Sales & Marketing

axoCells™

We have developed a catalog of functionally relevant iPSC-derived neurons, neuroinflammatory cells and cardiomyocytes manufactured at our ISO 9001:2015-accredited production facility. Our leading neuronal cell types include: **cortical excitatory neurons, striatal neurons, cortical inhibitory interneurons, microglia, astrocytes, sensory neurons and motor neurons**.

We also provide high-quality **atrial cardiomyocytes** and **ventricular cardiomyocytes**, as well as made-to-order **myotubes**.

'Ready-to-ship'

	axoCells kit code	iPSC-derived cells only	Donor	Disease	Gene/mutation
Cortical Excitatory Neurons	ax5111	ax0111	Female, 87	Alzheimer's disease	Apo E4/E4
	ax5112	ax0112	Female, 38	Alzheimer's disease	PSEN1 L286V
	ax5113	ax0113	Male, 53	Alzheimer's disease	PSEN1 M146L
	ax5114	ax0114	Female, 31	Alzheimer's disease	PSEN1 A246E
	ax5115	ax0015	Male, newborn	Healthy control	-
	ax5116	ax0016	Female, newborn	Healthy control	-
	ax5118	ax0018	Male, 74	Healthy control	-
Striatal neurons	ax3115	ax0015	Male, newborn	Healthy control	-
	ax3116	ax0016	Female, newborn	Healthy control	-
	ax3118	ax0018	Male, 74	Healthy control	-
	ax3211	ax0211	Female, 48	Huntington's disease	HTT: 50 CAG
Cortical Inhibitory Interneurons	-	ax0662	Male, 40-50	Healthy control	
	-	ax0667	Male, newborn	Healthy control	
Microglia	ax0679	ax0664	Male, 40-50	Healthy control	
Astrocytes	-	ax0665	Male, newborn	Healthy control	
Sensory Neurons		ax0555	Male, newborn	Healthy control	
	ax0157	ax0055	Male, newborn	Healthy control	
Motor Neurons		ax0073	Male, 62	ALS control (asymptomatic)	C9ORF72 >145 G4C2
		ax0074	Female, 64	ALS disease	C9ORF72 >145 G4C2
	ax0178	ax0078	Male, 74	Healthy control	
Ventricular Cardiomyocytes	ax2500	ax2508	Male, 74	Healthy control	
Atrial Cardiomyocytes	-	ax2518	Male, 74	Healthy control	
Cardiac Fibroblasts	-	ax3039	Adult	Healthy control	

'Made-to-Order'

Cell type	Viable cells per vial	~Time to deliver
Neurons and neuroinflammatory cells		
Neural Stem Cells (NSCs)	1.5M	4 weeks
Cortical Excitatory Neurons	1.5M	4 weeks
Striatal Neurons	1.5M	4 weeks
Cortical Inhibitory Interneurons	2M	4 weeks
Microglia	1M	17 weeks
Astrocytes from iPSCs	1M	29 weeks
Astrocytes from NSCs	1M	16 weeks
Sensory Neurons	0.5M	10 weeks
Motor Neurons	2M	13 weeks
Cardiac cells		
Ventricular Cardiomyocytes	2M	9 weeks
Atrial Cardiomyocytes	1M	9 weeks
Muscle cells		
Myotubes	1M	16 weeks

ISO 9001 quality

Our quality management system is ISO 9001 accredited and demonstrates excellent compliance with ISSCR Standards, demonstrating our commitment to quality and consistency.

What do we mean by 'functional QC'?

Functional QC (fQC) asks simply, are they useful in my assay. By applying fQC we test our iPSC-derived endpoint cells for functional performance with assays that are **biologically relevant** to the cell type and therapy area. This ultimately produces **higher-quality** product that can drive better translational power in robust *in vitro* models.

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axoLines™

We've developed a library of over 70 iPSC lines derived from fully-consented patient and healthy control donors. With full licenses and a 50:50 split of male to female donors, our axoLines iPSCs can be used for axoServices custom lab services, made-to-order axoCells projects and specific licensing arrangements.

Key therapy areas include **Alzheimer's Disease**, **Parkinson's Disease**, **ALS**, **Huntington's Disease**, **Friedreich's Ataxia** and **Frontotemporal Dementia**.

5 ALS lines

- We have 5 iPSC lines reprogrammed from patients with ALS (**SOD1**, **TDP43** and **C9ORF72** mutations):
- *CENSOi035-B,* an iPSC reprogrammed from a 61-year-old female with ALS (**SOD1** mutation)
- *CENSOi018-A,* an iPSC reprogrammed from a 62-year-old female with ALS (**TDP43** mutation)
- We also have the interesting combination of a disease line derived from 64-year-old female with ALS (**C9ORF72** mutation) and a control line from their sibling, a 62-year-old male with a **C9ORF72** mutation who was **asymptomatic** at the time of sampling
- We also have a disease control line reprogrammed from a 44-year-old female with a **C9ORF72 mutation** (**asymptomatic** at time of sampling).

7 Alzheimer's Disease lines

- We have 7 iPSC lines reprogrammed from patients with Alzheimer's Disease (**APOE4** and **PSEN1** mutations)
    - **Examples include:**
        - An iPSC reprogrammed from an 87-year-old female with Alzheimer's Disease (**APOE4** mutation)
        - An iPSC reprogrammed from a 53-year-old male with Alzheimer's Disease (**PSEN1** mutation)
        - For a control line, we recommend the *CENSOi004-E line* reprogrammed from a 40-50-year-old male.

14 Parkinson's Disease lines

- We have 14 iPSC lines reprogrammed from patients with Parkinson's Disease representing mutations in **Ataxin-3**, **PINK1**, **PARKIN**, **PARK2**, **SNCA** and **LRRK2**
    - **Examples include:**
        - *CENSOi028-A,* an iPSC reprogrammed from a 52-year-old female with Parkinson's Disease (**PINK1**)
        - *CENSOi030-A,* an iPSC reprogrammed from a 54-year-old female with Parkinson's Disease (**SNCA**)
        - For a control line, we recommend *CENSOi004-E* reprogrammed from a 40-50-year-old male.

6 Huntington's Disease lines

- We have 6 iPSC lines reprogrammed from patients with Huntington's Disease representing mutations in **HTT**
    - **Examples include:**
        - *CENSOi017-A,* an iPSC reprogrammed from a 51-year-old female with Huntington's Disease (**HTT**)
        - *CENSOi053-A,* a disease control line reprogrammed from a 64-year-old male who was **asymptomatic at the time of sampling** (**HTT**).

We have included the full list overleaf, but you can also visit our axoLines page at https://axolbio.com/axolines/ or scan the QR code. We also have **gene editing and R&D licensing capabilities** for some of our axoLines: contact operations@axolbio.com if you have any queries.

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Below you can find a complete list of our iPSC lines:

Control Lines	Status at time of sampling	Gender	Age of sampling	Source of sampling	iPSC cell line		
Control	No disease diagnosis	Male	40-50	Fibroblasts	CENSOi004-E		
	No disease diagnosis	Male	Newborn	Cordblood	ax7015		
	No disease diagnosis	Female	Newborn	Cordblood	ax7016		
	No disease diagnosis	Male	74	Pulmonary fibroblast	ax7018		

Disease Lines	Status at time of sampling	Gender	Age at sampling	Source material	Mutation	Variant	IPSC cell line
ALS	Patient	Female	61	Fibroblasts	SOD1	Heterozygous D109Y (G>T) mutation	CENSOi035-B
	Asymptomatic (Sibling to ax7074)	Male	62	Dermal fibroblast	C9ORF72: >145 G4C2		ax7073
	Patient (Sibling to ax7073)	Female	64	Dermal fibroblast	C9ORF72: >145 G4C2		ax7074
	Asymptomatic	Female	44	Fibroblasts	C9ORF72	Heterozygous >100 expanded GGGGCC	CENSOi027-D
	Patient (also with FTD)	Female	62	Fibroblasts	TARDBP	TARDBP: A382T	CENSOi018-A
Alzheimer's disease	Patient	Female	31	Dermal fibroblast	PSEN1 A246E	ApoE: E3/E4	ax7114
	Patient	Male	53	Dermal fibroblast	PSEN1 M146L	ApoE: E2/E3	ax7113
	Patient	Female	38	Dermal fibroblast	PSEN1 L286V	ApoE: E2/E3	ax7112
	Patient	Female	87	Dermal fibroblast	ApoE	ApoE: E4/E4	ax7111
	Patient	Female	59	PBMCs	ApoE	ApoE: E3/E3	CENSOi070-A
	Patient	Male	60	PBMCs	ApoE	ApoE: E3/E4	CENSOi074-A
	Patient	Female	52	PBMCs	ApoE	ApoE: E3/E4	CENSOi077-C
Behavioural variant frontotemporal dementia (bvFTD)	Patient	Male	65	Fibroblasts	MAPT	Heterozygous c.1920+16C>T in the MAPT gene	CENSOi059-A
	Patient	Male	68	Fibroblasts	MAPT	Heterozygous c.1920+16C>T	CENSOi060-B
	Patient	Male	59	Fibroblasts	MAPT	Heterozygous c.1920+16C>T	CENSOi061-A
Charcot-Marie-Tooth Disease, Type 4J (CMT4J)	Patient	Male	27	PBMCs	FIG4	Heterozygous c.122T>C p.(Ile41Thr) exon 2	CENSOi068-A
Dentatorubral-pallidoluysian atrophy (DRPLA)	Patient	Male	16	Fibroblasts	ATN1	Heterozygous repeats 1 allele (approximately 13 repeats) in the normal range and one allele (approximately 66 repeats)	CENSOi054-B
	Patient	Male	51	Fibroblasts	ATN1	Heterozygous pathogenic repeat expansion in the ATN1 gene (17 ± 1/ 57 ± 2 CAG repeats)	CENSOi055-A
	Asymptomatic	Female	45	Fibroblasts	ATN1	ATN1:12±1/ 13±1 CAG repeats (normal range)	CENSOi058-A
Epilepsy	Patient	female	5mo	Dermal fibroblast	Undetermined	Unknown	ax7411
Friedreich's Ataxia	Patient	Male	21	Fibroblasts	FXN	Homozygous repeat expansion (>75 GAA repeats)	CENSOi037-A
	Patient	Female	17	Fibroblasts	FXN	Homozygous repeat expansion in the FXN gene (>75 GAA repeats)	CENSOi044-A
	Patient	Male	23	Fibroblasts	FXN	Two pathogenic expanded alleles in the FXN gene (≥66 GAA repeats)	CENSOi048-A
	Patient	Male	34	Fibroblasts	FXN	Homozygous repeat expansion (>75 GAA repeats)	CENSOi050-A
	Asymptomatic	Male	44	Fibroblasts	FXN	Homozygous 8±1 GAA repeats	CENSOi039-A
	Asymptomatic	Female	Unknown	Fibroblasts	FXN	Heterozygous repeat expansion (>75 GAA repeats)	CENSOi038-A
Frontotemporal dementia (FTD)	Patient	Female	54	PBMCs	MAPT	Heterozygous MAPT, c.1920+16C>T	CENSOi069-B
	Patient	Female	42	PBMCs	MAPT	Heterozygous MAPT, c.1920+16C>T	CENSOi072-A
	Patient	Male	35	PBMCs	MAPT	Heterozygous MAPT, c.1920+16C>T	CENSOi076-A
	Asymptomatic	Female	46	Fibroblasts	MAPT	Heterozygous c.1920+16C>T	CENSOi062-A
	Patient	Female	31	Fibroblasts	Progranulin	R493X	CENSOi025-A
	Patient	Male	65	Fibroblasts	Progranulin	C31FS	CENSOi032-A
FTD, Paget's Disease	Patient	Female	43	Fibroblasts	VCP	Heterozygous VCP R155C (CGT>TGT)	CENSOi042-A
	Patient	Male	42	Fibroblasts	VCP	Heterozygous VCP R191Q c.572 G>A	CENSOi043-A
Huntington's Disease	Patient	Male	16	Fibroblasts	HTT	1 allele within the intermediate range (approximately 28 repeats) and 1 alelle within the expanded range (approximately 66 repeats)	CENSOi052-A
	Patient	Female	48	Dermal Fibroblast	HTT	50 CAG repeat	ax7211
	Patient	Female	40-50	Fibroblasts	HTT	18/39 CAG repeats in HTT	CENSOi011-D
	Patient	Female	51	Fibroblasts	HTT	One HTT allele with CAG repeats in normal range, one HTT allele carrying approximately 42 CAG repeats	CENSOi017-A
	Patient	Female	7	Fibroblasts	HTT	One HTT allele with CAG repeats in normal range, one HTT allele carrying approximately 127 CAG repeats	CENSOi019-B
	Asymptomatic	Male	64	Fibroblasts	HTT	Carrier. One allele in normal range (approximately 17 CAG repeats)/ one expanded allele in affected range (approximately 38 CAG repeats)	CENSOi053-A
Mucolipidosis IV (ML4)	Patient	Female	10	PBMCs	MCOLN1	Homozygous MCOLN1, c.406-2A>G	CENSOi064-A
	Patient	Male	45	PBMCs	MCOLN1	Heterozygous, MCOLN1, c.406-2A>G	CENSOi065-B
	Patient	Male	7	PBMCs	MCOLN1	Heterozygous, MCOLN1, c.694A>C p.(Thr232Pro); Heterozygous, MCOLN1, c.785T>C p.(Phe262Ser)	CENSOi066-A
	Asymptomatic	Female	36	Fibroblasts	MCOLN1	Heterozygous MCOLN1, c.785T>C	CENSOi063-A
Nasu-Hakola disease	Patient	Female	41	PBMCs	TREM2	Homozygous TREM2, c.150G>T p.(Trp50Cys)	CENSOi073-A
	Patient	Female	69	PBMCs	TREM2	Heterozygous TREM2, c.150G>T p.(Trp50Cys)	CENSOi075-B
	Patient	Male	68	PBMCs	TREM2	Heterozygous TREM2, c.150G>T p.(Trp50Cys)	CENSOi078-A
Parkinsonism/Machado-Joseph disease/ (SCA3)	Patient	Male	50	Fibroblasts	ATXN3	14/69 CAG repeats in ATXN3 gene	CENSOi021-A
	Patient	Female	53	Fibroblasts	ATXN3	26/70 CAG repeats in ATXN3	CENSOi022-A
	Patient	Male	41	Fibroblasts	ATXN3	25/69 CAG repeats	CENSOi033-A
	Patient	Male	50	Fibroblasts	ATXN3	29/66 CAG repeats	CENSOi034-A
	Patient	Male	22	PBMCs	ATXN3	14/75 CAG repeats	CENSOi071-A
Parkinson's Disease	Patient	Female	48	Fibroblasts	PINK1 & PARKIN	PINK1: Tryp90Leufsx12 PARKIN: Arg275Trp	CENSOi023-A
	Patient	Male	75	Fibroblasts	PINK1 & PARK2	Heterozygous PARK2 variant c.823C>Tp.(Arg275Trp). Heterozygous PINK1(W9OLfsx12) (Tryp90Leufsx12)	CENSOi024-A
	Patient	Male	58	Fibroblasts	PINK1 & PARK2	Homozygous c.736C>T;p.Arg246 X mutation in the PINK 1 gene Heterozygous deletion encompassing exon 4 to 6 in the PARK2 gene	CENSOi026-C
	Patient	Female	52	Fibroblasts	PINK1	PINK1: Homozygous p.Tryp90Leufsx12	CENSOi028-A
	Patient	Female	54	Fibroblasts	SNCA	A53T	CENSOi030-A
	Patient	Male	54	Fibroblasts	SNCA	A53T	CENSOi031-A
	Patient	Female	48	Fibroblasts	SNCA	Heterozygous G51D (G>A) mutation	CENSOi045-A
	Patient	Male	68	Fibroblasts	LRRK2	Heterozygous LRRK2(WT/G2019S)	CENSOi046-A
	Patient	Male	59	Fibroblasts	LRRK2	c.4321C>T (p.Arg1441Cys)	CENSOi047-A
SCA2	Patient	Male	41	Fibroblasts	ATXN2	22/38 CAG repeats in ATXN2	CENSOi020-A
SCA7	Patient	Female	61	Fibroblasts	ATXN7	10/39 CAG repeats	CENSOi036-A
Spinal and bulbar muscular atrophy (SBMA)	Patient	Male	66	Fibroblasts	AR	Hemizygous expansion (47±1 CAG repeats)	CENSOi040-A
Spinocerebellar ataxia type 2 (SCA2)	Patient	Male	58	Fibroblasts	ATXN2	1 CAG repeat allele within the normal range (approximately 22 repeats) and one allele within the SCA2 affected range (approximately 36 repeats)	CENSOi051-B
Spinocerebellar ataxia type 2 (SCA2)	Patient	Female	Unknown	Fibroblasts	ATXN2	One CAG repeat allele within the nromal range (approximately 22 repeats) and one allele within the SCA2 affected range (approximately 39 repeats)	CENSOi057-B
Spinocerebellar ataxia type 6 (SCA6)	Patient	Female	63	Fibroblasts	CACNA1A	1 CAG repeat allele within the normal range and one allele within the SCA6 affected range (approximately 23 repeats)	CENSOi056-A

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axoServices™

With over a decade of expertise, Axol Bioscience is established as the **first choice** for professional, QC-rich delivery of outsourced iPSC-related services, working always to our values of performance and transparency.

With a mantra of **"do it once, and do it well"**, we've developed a comprehensive suite of custom lab services. Leave us to do the "heavy lifting", while you get on with the science.

Technical Services

| Service	Deliverable	Timelines
Reprogramming	iPSCs with QC to demonstrate viability and pluripotency markers, with no adventitious viruses/mycoplasma.	From 21-27 weeks (includes 4 weeks standard QC)
Gene-editing	Gene-edited iPSCs with QC. As above plus iPSCs tested for robustness to nucleofection and subcloning, screened for PCR and sequencing to ensure correct targeting, and expanded into banks.	From 28 weeks or longer depending on complexity
Differentiation	Vials of frozen iPSC-derived cells with functional QC. Flow cytometry of iPSCs to confirm pluripotency-associated marker expression. On derived cells, ICC to confirm expression lineage-specific markers, checks for contaminants and viability testing.	From 4 weeks depending on cell type
Model building	A collaborative iPSC-fueled model that has been built and validated with measurable endpoints and controls.	Custom project
Compound screening	Small-scale pilot experiments to optimize assay selection, with progression to larger-scale screening. Full written report and data sharing.	Custom project

Cellular Assays

We have a range of in-house and outsourced services to support cellular and model QC and compound screening projects.

Our specialties include:
- Multi-electrode array (MEA)
- Real-time imaging
- Immunocytochemistry
- Confocal and fluorescence microscopy
- Protein and genomic analysis
- Flow cytometry
- Plate-based assays

AXOL

axoModels™
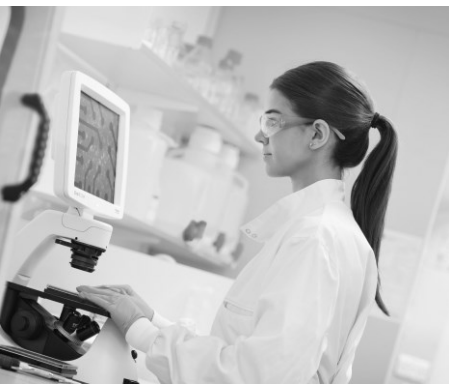
We work collaboratively with biopharma organizations to build, assess, and execute advanced in vitro test systems. Guided by our in-house expertise, these models are powered by functional iPSC-derived cells and offer excellent translational potential for research and compound screening. **Each project is unique**, and we work with clients to develop, assess then use these models.

Core model types

Below you can find core in-house models that we can develop in collaboration with groups looking to harness the power of functionally-relevant axoCells.

Model Types	Cells used in model	Example measurements performed and their utility
ALS v1 (MN) **Amyotrophic lateral sclerosis**	Healthy vs. ALS patient-derived motor neurons	We would use multi-electrode array (MEA) and real-time calcium flux imaging to identify hyperexcitability and loss of synchronicity. We would also use real-time plate imaging to monitor neurite structure.
ALS v2 (NMJ) **Amyotrophic lateral sclerosis**	Healthy vs. ALS motor neurons & skeletal muscle	We would use MEA and real-time calcium flux imaging to identify hyperexcitability and loss of synchronicity. We would also use real-time plate imaging to monitor neurite structure and measure muscle contractility via MEA.
Pain	Sensory neurons	We would look for changes in expression levels of key TRP and NaV channels via RNAseq and immunofluorescence. We would also use MEA and calcium imaging to look for evidence of toxicology, pharmacology, habituation to treatments, measuring parameters that include neuronal activity, capsaicin response, desensitization and tachyphylaxis. We could also use high-content imaging to monitor neurite structure, looking for changes in neurite structure indicating toxicology.
Alzheimer's Disease	Spontaneous Alzheimer's Disease (sAD) vs control-derived cortical excitatory neurons, cortical inhibitory neurons, astrocytes & microglia	We would use proteomics to assess cytokine release, using proteomics platforms that measure 30-40 cytokines per well. We would also use genomics to assess RNAseq / genome open reading frame RNA analysis from 96-well array data. High-content imaging would enable us to assess phagocytosis/spontaneous neural activity / high-content imaging in 96-well/384-well format.
Neuroinflammation	Healthy vs. AD patient-derived microglia and cortical neurons	We would use high-content imaging to assess phagocytosis, cytokine release, chemotaxis and cortical firing – demonstrating immune response and dysfunction of microglia in neurodegeneration. MEA can be used to measure neuronal activity in co-culture models.
Huntington's Disease (HD)	Healthy vs. HD patient-derived striatal neurons	We would use MEA and real-time calcium flux imaging to measure neuronal/calcium channel activity respectively, to identify hyperexcitability and loss of synchronicity in disease model. We would also use high-content imaging to monitor neurite structure (fewer, shorter neurites would indicate neurodegeneration) and PCR/blotting to assess the genomic stability of CAG repeats – assessing disease phenotype with compound treatment effect.
Parkinson's Disease (PD)	Healthy vs. PD patient-derived dopaminergic neurons	We would use MEA and real-time calcium flux imaging to measure neuronal/calcium channel activity respectively, to identify hyperexcitability and loss of synchronicity in disease model. We would also use high-content imaging to monitor neurite structure (fewer, shorter neurites would indicate neurodegeneration)

For more information, scan the QR code on this page or email us at operations@axolbio.com.

AXOL

Collaborative at heart.

We believe in the power and potential of human iPSCs. If you share this belief, let's work together for mutual success.

We work collaboratively with charitable, academic, regulatory and industrial partners to create ambitious and novel *in vitro* platforms that drive drug discovery forward.

So we ask you:

iPSCs? How can we help?

Learn more.

Access eBooks, posters, papers and protocols at:

www.axolbio.com

Interested? Let's talk.

operations@axolbio.com