Homolog/ Ortholog	***C. elegans* *gene***	**Sequence name**	**Type**	**Ligand**	**Expression pattern***	**Properties**	**Other notes**	**References****
NEUROTRANSMITTER RECEPTORS								
SEROTONIN (5HT)								
Receptors								
5-HT2	*ser-1 (5-HTCe*	*F59C12.2*	G protein-coupled receptor (GPCR) (Gαq); 7-transmembrane (7TM); coupled to Ca++ signaling	**Serotonin (a-methyl 5-HT for SER-1)**	RIA, RIC, URY (inconsistent), head, tail, ventral cord motor neurons, pharyngeal muscles (pm3, pm4, pm5, pm6, pm7, pm8), vulval muscle (variable expression depending on construct), PVT, PVQ, other tail neurons and some ray neurons, diagonal muscles of male, VNC motor neurons (not VCs), ray neurons, uterine cells, posterior intestine	Metabotropic 5-HT receptor. SER-1 has low affinity for 5-HT, and a mixture of pharmacological similarities to mammalian 5-HT1 and 5-HT2 receptors	SER-1 is stimulated by alpha-methyl-5-HT, and probably antagonized by methiotheptin. SER-1 is required in both vulval muscle and neurons for the stimulation of egg-laying by 5-HT, but is completely dispensable for stimulation by the uptake inhibitor fluoxetine, and mostly dispensable for stimulation by the tricyclic antidepressant imipramine; SER-1 and SER-7 are redundantly required for normal egg-laying. SER-1 is required for normal turning during male mating (ser-1 mutants show reduced male tail curling in exogenous 5-HT, but retain mating ability in the laboratory). SER-1 is weakly required for pharyngeal pumping. Stimulation of heterologously expressed SER-1 induces a rise in free intracellular calcium.	Komuniecki et al, 2004; Carnell et al, 2005; Xiao et al 2006; Chase and Koelle 2007; Hapiak et al, 2009
5-HT1	*ser-4, (ce*	*Y22D7AR.1*	7TM GPCR (Gαi/o); attenuates adenylyl cyclase activity	**Serotonin**	RIB and RIS, other head, pharyngeal neur	Metabotropic 5-HT receptor. Low affinity for 5-HT, overall has 5-HT1 properties	Heterologously expressed SER-4 diminishes intracellular adenylate cyclase activity in response to 5-HT. SER-4 is required for normal inhibition of movement by 5-HT (ser-4 mutants are hyperactive). It is partly required for male tail curling (ser-4 mutants show reduced curling in exogenous 5-HT), but is dispensable for the stimulation of egg-laying by 5-HT and by the uptake inhibitor fluoxetine. SER-4 may actually inhibit egg-laying, since egg-laying ser-4 mutants are moderately hypersensitive to 5-HT, and mutant ser-4 hermaphrodites are partly depleted of eggs, suggesting that their egg-laying is weakly constitutive; however, SER-4 is required for stimulation of egg-laying by the tricyclic antidepressant imipramine.	Olde and McCombie 1997;Tsalik et al, 2003; Dempsey et al, 2005; Carre-Pierrat et al, 2006
5-HT6	*ser-5*	*F16D3.7*	7TM GPCR; independent of adenylyl cyclase activity	**Serotonin**	ASH, AWB, head and tail neurons, vulval muscle, body wall muscle, intestine	Metabotropic 5-HT receptor.	SER-5 functions in the ASH chemosensory neurons to coordinate sensory input and locomotory behavior and in muscles to regulate the effects of 5-HT on egg laying; heterologously expressed ser-5 has no effect on adenylate cyclase signaling	Carre-Pierrat et al, 2006; Harris et al, 2009
5-HT7	*ser-7*	*C09B7.1*	7TM GPCR (Gαs); activates adenylyl cyclase activity	**Serotonin**	Head and tail neurons, pharyngeal neurons (I2, I3, I4, I6, M2, M3, M4, M5, MC), vulval muscles, and intestine	High affinity for 5-HT and tryptamine, but not for 5-CT (5-Carboxamidotryptamine).	Heterologously expressed ser-7 stimulates intracellular adenylate cyclase activity in response to 5-HT. SER-7 is required for stimulation of egg-laying or pharyngeal pumping by 5-HT, for regular pumping in response to bacteria, and probably also for 5-HT to activate MC neurons; SER-7 and SER-1 are redundantly required for normal egg-laying.	Hobson et al, 2003 and 2006
?	*mod-1*	*K06C4.6*	5-HT-gated chloride channel	**Serotonin**	AIA, AIB, AIY, AIZ, RIC, RID, RIM and other head neurons, VNC neurons, tail neurons, not in muscle cells		MOD-1 channel and the SER-6 GPCR play specific roles in 5-HT-induced fat reduction and they define distinct mechanisms mediating serotonergic fat regulation. mod-1 ; ser-6 double mutants have higher fat levels than the single mutants.	Ranganathan et al, 2000; Wenick and Hobert, 2004; Srinavasan et al, 2008; Luedtke et al, 2010, Li et al, 2012
	lgc-50	T20B12.9	Ligand-gated ion channel (mod-1 group)					Jones and Sattelle, 2008
Homolog/Ortholog	***C. elegans gene***	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**
DOPAMINE (DA)								McDonald et al, 2006
Receptors								
D1-like	*dop-1*	*F15A8.5*	7TM GPCR (Gαs)	**Dopamine**	ALM, ALN, AUA, AVM, PHC, PLM, PLN, PVQ, PVD, RIB, RIM, RIS, some unidentified neurons in the head, cholinergic VNC motor neurons, interneurons, excretory gland cells, head muscles, and sensory neuronal support cells	When coexpressed with bovine or C. elegans Gas, DOP-1 stimulates potassium channel activity.	DOP-1 is required cell autonomously in the touch neurons for modulation of mechanosensory behaviors such as tap habituation. It is required for regulation of locomotion via antagonism of the DOP-3 in cholinergic neurons. RNAi leads to slower anterior movement, poor reversals and poor touch response. DOP-3 and DOP-1 probably counter one another through the GOA-1/Galpha(o) and EGL-30/Galpha(q) signaling pathways	Tsalik et al, 2003; Sanyal et al, 2004
D2-like	*dop-2 (dop-2L*	*K09G1.4*	7TM GPCR (Gαi/o)	**Dopamine**	ADE, CEP, PDA, PDE, RIA, RID, SIA, SIB,			Suo et al, 2003 and 2004; Tsalik et al, 2003
D2-like	*dop-3*	*T14E8.3*	7TM GPCR	**Dopamine**	ASE, PVD, RIC, SIA, other head and tail neurons, cholinergic (weak) and GABAergic (strong) VNC motor neurons, bodywall muscles		Required for the normal slowing of locomotion by well-fed animals moving onto a bacterial lawn ('basal slowing'), but not for the enhanced slowing of starved animals ('enhanced slowing response'); DOP-3 is also required for the paralysis of animals by excess dopamine, with dop-3 mutants showing significant resistance to such paralysis; DOP-3 is antagonized by DOP-1 (since a dop-1 mutation suppresses the dop-3 slowing and paralysis mutant phenotypes). DOP-3 and DOP-1 probably counter one another through the GOA-1/Ga(o) and EGL-30/Ga(q) signaling pathways. DOP-3 and DOP-1 are coexpressed in cholinergic motor neurons and PVD mechanosensory neurons, and exert their antagonistic effects in the former. dop-3 mutants share a dopamine-resistant phenotype with goa-1, dgk-1, eat-16 and gpb-2 mutants	Chase et al, 2004; Chase and Koelle 2007; Suo et al, 2009
Human TAR vs D1-like	*dop-4*	*C52B11.3*	7TM GPCR (Gα?)	**Dopamine**	ASG, AVL, CAN, I1, I2, PQR, other head neurons (weak and variable expression), ASH, male ray 8, vulval cells, intestine, rectal gland, rectal epithelium		Food acutely enhances ASH-mediated aversive responses (eg to copper or glycerol) via dopaminergic signaling; bacteria are sensed by the mechanosensory CEP neurons that release DA to enhance somatic calcium transients in ASH via DOP-4 receptor, and increase ASH-driven avoidance behavior	Komuniecki et al, 2004; Sugiura et al, 2005, Ezcurra et al., 2011; Sengupta, 2013
Homolog of human melatonin type 1b receptors, and more generally of mammalian dopamine and serotonin (5-HT) receptors	*dop-5*	*T02E9.3*	7TM GPCR (Gα?)	**Dopamine? Serotonin?**	ASE, other head and tail neurons		Required for full sensitivity to 5-HT, normal brood sizes and pharyngeal pumping, partly required for male tail curling	Komuniecki et al, 2004; Carre-Pierrat et al, 2006
D2 or D3 dopamine receptors (mammalian homolog)	*dop-6*	*C24A8.1*	7TM GPCR (Gα?)	**Dopamine**	Head neurons; unidentified cells in tail		DOP-6 might act redundantly with DOP-2 to promote the basal slowing response to bacterial feeding, or it might account for the residual response to excess dopamine seen in triple dop-1/-2/-3 mutant. DOP-6 otherwise has no obvious function in RNAi assays of brood size, egg laying, pharyngeal pumping, locomotion, or male mating	Keating et al, 2003; Komuniecki et al, 2004; Carre-Pierrat et al, 2006
Ligand unspecified								
	C24A8.6	*C24A8.6*	GPCR for small molecule neurotransmitters. 7TM rhodopsin family. Closest to C24A8.1 in phylogenetic tree	**?**				Keating et al, 2003
Homolog/ Ortholog	***C. elegans gene***	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**
OCTOPAMINE (OA)								
Receptors								
	octr-1	*F14D12.6*	7TM GPCR (Gαs?)	**Octopamine**	Exclusively in a subset of head and tail neu		Octopaminergic inhibition of ASH-mediated aversive responses is mediated by three different octopamine receptors; OCTR-1 , SER-6 and SER-3. OCTR-1 and SER-3 antagonistically modulate ASH signaling directly, while SER-6 activates peptidergic signaling cascades by stimulating the release of inhibitory neuropeptides. OCTR-1 acts in ASH and ASI to actively suppress innate immune responses by down-regulating the expression of noncanonical unfolded protein response genes in nonneuronal tissues.	Chase and Koelle, 2007; Komuniecki et al, 2004; Wragg et al, 2007; Mills et al., 2012
5HT4	*ser-3*	*K02F2.6*	7TM GPCR (Gαq/Gαs?)	**Octopamine/ serotonin?**	Pharynx, head (including SIA, ASH) and tail (PHA, PHB, PVQ) neurons, head muscles, phasmid sockets, nerve ring, and intestine, spermatheca, eggs, gonad, vulva.	Mixed 5HT1 and 5HT2 properties, low affinity for 5HT, alpha-methyl 5HT as an agonist, mianserin as an agonist. SER-3 activity is required for normally high brood sizes and for embryonic development, and weakly required for pharyngeal pumping.	SER-3 is required in the SIA neurons for response to the absence of food and to exogenous octopamine. Along with SER-4, SER-3 mediates the dietary restriction-based lifespan-extending effects of mianserin, in C. elegans; when expressed in HEK293 cells, ser-3 mediates a response to octopamine and to tyramine, but not serotonin. SER-3 is required for normal inhibition of movement by 5-HT, with ser-3 mutants being hyperactive and excessively curling their male tails. SER-3 activity is also required for normally high brood sizes and for embryonic development, and weakly required for pharyngeal pumping. Octopaminergic inhibition of ASH-mediated aversive responses is mediated by three different octopamine receptors; OCTR-1 , SER-6 and SER-3. OCTR-1 and SER-3 antagonistically modulate ASH signaling directly, while SER-6 activates inhibitory peptidergic signaling cascades by stimulating the release of an array of neuropeptides.	Carre-Pierrat et al, 2006; Suo et al, 2006; Mills et al., 2012

	ser-6	*Y54G2A.35*	7TM GPCR (Gαq)	**Octopamine**	Head neurons, including the AWB, ADL and ASI sensory neurons, posterior ventral cord motor neurons and the intestine.	Couples to Gαq in Xenopus oocytes.	SER-6 functions as part of a signaling pathway that mediates serotonin-induced fat reduction via transcriptional regulation of lipid oxidation genes. mod-1 and peripherally expressed metabolic genes define a pathway of serotonergic fat regulation that is mechanistically distinct from that defined by ser-6. Octopaminergic inhibition of ASH-mediated aversive responses is mediated by three different octopamine receptors , OCTR-1 , SER-6 and SER-3. The activation of SER-6 in the AWB, ADL and ASI sensory neurons stimulates the release of a large and diverse group of peptides that ultimately inhibit ASH-mediated aversive responses.	Komuniecki R, pers. comm.; Mills et al., 2012; Srinavasan et al, 2008

Homolog/ Ortholog	***C. elegans* *gene***	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**
TYRAMINE (TA)								Branicky and Schafer, 2009
Receptors								
	ser-2	*C02D4.2*	7TM GPCR (Gαi/o)	**Tyramine**	Some pharyngeal cells, head mucles. ser-2A: AIY, ALN, AUA, AVH, CAN, DA9, LUA, NSM, PVC, RIA, RIC, RID, SABD, SABV, SDQ, head muscles, diagonal muscles, pm1/6 muscles. ser-2B: AIY, AIZ, BDU, DVA, PVT, RID, RME, SIAD, SIAV, excretory gland. ser-2d: OLL and PVD. ser-2: AIY, AVH, AIZ, ALN, BDU, PDA, RIA, RIC, RID, RME, ut1, ut2	Encodes at least four tyramine 7 TM domain receptors (GPCRs), by alternative splicing from three different promoters, that have distinct but partially overlapping expression patterns	The deletion ser-2(pk1397) mutant has no obvious phenotype	Rex and Komuniecki 2002; Tsalik et al, 2003; Komuniecki et al, 2004
5HT5	*tyra-2*	*F01E11.5*	7TM GPCR (Gαi/o vs Gα?)	**Tyramine**	MC and NSM pharyngeal neurons, the AS			Komuniecki et al, 2004; Rex et al, 2005
	tyra-3	*M03F4.3*	7TM GPCR (Gαq); independent of adenylyl cyclase activity	**Tyramine** **Octopamine**	CEP, ADE, tail neurons, and vulva		TYRA-3 acts in sensory neurons that detect environmental cues, suggesting that the internal catecholamines detected by TYRA-3 regulate responses to external conditions. Natural variation in TYRA-3 affects food patch leaving, a behaviour representative of the exploration–exploitation decision (i.e., the time at which animals choose to abandon a depleting food supply to restart foraging). Tyramine and octopamine independently inhibit serotonin-stimulated aversive behaviors through TYRA-3 and OCTR-1, respectively. TYRA-3 is required for normal inhibition of movement by 5-HT, with tyra-3(RNAi) animals being hyperactive.	Chase et al, 2004; Carre-Pierrat et al, 2006; Wragg et al, 2007, Bendesky et al., 2011
	lgc-55	*Y113G7A.5*	Ligand-gated ion (chloride) channel	**Tyramine?**	ALN, AVB, HSN, IL1D, IL1V, RMD, SMDD, SMDV, SDQ, uv1, neck muscles, tail muscle		Touch to the anterior of the animal activates the AVA backward locomotion command interneuron, which in turn activates the tyraminergic RIM mototr neuron. Tyramine release from the RIM neurons activates the tyramine-gated chloride channel LGC-55, which is expressed in the forward locomotion command interneuron AVB and cells of the head movement circuit; RMD. SMD, and neck muscles. Activation of LGC-55 causes hyperpolarization of neck muscles and the AVB neuron inducing the suppression of head movements and sustained backward locomotion in response to anterior touch.	Pirri et al, 2009; Pirri and Alkema, 2011

Homolog/ Ortholog	***C. elegans* *gene***	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**
TRACE AMINES								Branicky and Schafer, 2009
Candidate GPCRs predicted to bind either small-molecule neurotransmitters (trace amine-associated (TAA) receptors) or neuropeptides								
	F59D12.1	F59D12.1	GPCR. 7TM rhodopsin family. GPCR for small molecule neurotransmitters. Closest to T02E9.3 in phylogenetic tree.	**Melatonin?**			Animals look slow and paralyzed with RNAi against F59D12.1. Exogenously applied melatonin decreases locomotion rates in 15 min treatments, suggesting that melatonin directly regulates neural activities for locomotion. This melatonin signaling functions through MT1-like melatonin receptors, because the MT1\/2 receptor antagonist luzindole effectively blocked the effect of melatonin on locomotion, while MT2-specific antagonist 4-phenyl-2-propionamidotetralin (4-P-PDOT) and MT3-selective antagonist prazosin had no effect. Alternatively, long-term treatment with prazosin specifically altered homeostatic states of the worm, suggesting another melatonin-signaling pathway through MT3-like receptors	Keating et al, 2003; Tanaka et al, 2007
	T21B4.4	T21B4.4	GPCR. 7TM rhodopsin family. GPCR for small molecule neurotransmitters. Closest to F42D1.3 in phylogenetic tree. Serpentine receptor class sx (Srsx)	**?**				Keating et al, 2003

Homolog/ Ortholog	**C. elegans gene**	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**
ACETYLCHOLINI								
Receptors								
	gar-1 (acm-1)	*C15B12.5*	Muscarinic. GPCR	**Ach**	Some head neurons with ciliated endings a	Although gar-1 is most closely related to muscarinic acetylcholine receptors (mAChR), it is pharmacologically distinct from them in its response to certain ligands; e.g. oxotremorine, atropine, scopolamine and pirenzepine do not work on GAR-1 and GAR-2 as effectively as they do on GAR-3. Electrophysiological studies indicate that gar-1 couples to the inhibitory subunit of G proteins (Gi) and not to Gs or to Go/Gq.	RNAi leads to sluggish animals	Lee et al, 2000; Park et al, 2000; Keating et al, 2003
	gar-2 (formerl	*F47D12.1*	Muscarinic. GPCR	**ACh**	AIY, Ciliated head neurons, ventral cord mc	When expressed in Xenopus oocytes treated with acetylcholine, gar-2 is able to activate a mammalian G protein-activated inwardly rectifying K+ (GIRK1) channel, but not other channels, suggesting that GAR-2 couples to G proteins of the Gi family. Pharmacological analyses indicate that GAR-2 exhibits properties distinct from mammalian muscarinic AChRs; GAR-2 is not inhibited by muscarinic antagonists (atropine , scopolamine, and pirenzepine), and muscarinic ligands (such as oxotremorine, atropine, scopolamine and pirenzepine) do not work on GAR-1 and GAR-2 as effectively as they do on GAR-3.		Lee et al, 2000; Park et al, 2000; Wenick and Hobert, 2004
	gar-3 (aka acr	*Y40H4A.1*	Muscarinic. GPCR	**ACh**	Pharyngeal muscle, I3, in neurons of the extrapharyngeal nervous system, anal depressor muscle, VD and DD ventral cord neurons, some tail and nerve ring neurons, and body wall muscles. Male-specific SPC motor neurons, PCB and PCA postcloacal sensilla neurons and male spicule protractor muscles	GAR-3 appears most similar to mammalian muscarinic ACh receptors (mAChRs), among the three G-protein-linked ACh receptors.	Required for regulation of membrane potential and excitation-contraction coupling in pharyngeal muscle and thus, for normal feeding behavior. GAR-3 likely acts upstream of GPB-2, a G-protein beta-subunit in regulation of pharyngeal pumping	Hwang et al, 1999; Park et al, 2003; Steger and Avery, 2004; Liu et al, 2007; Rand, 2007
unc-29 group	*lev-1 (aka acr*	*F09E8.7*	nAChR (nicotinic acetylcholine receptor). Ligand-gated cation (Ca++/Na+) channel. unc-29 group; non-alpha subunit.	**ACh**	All body wall muscle cells and a subset of ventral cord motor neurons	nAChRs are pentameric membrane proteins that are ligand-gated cation channels and mediate fast synaptic transmission at neuromuscular junctions and in the nervous system. Subunits of nAChRs fall into two main categories: alpha subunits are defined by adjacent cysteines which contribute to the ACh binding site, while non-alpha subunits lack this motif. LEV-1, a non-alpha subunit, forms a ligand (levamisole)-gated cation channel when coexpressed with UNC-29 (non-alpha subunit) and UNC-38 (alpha subunit) or UNC-63 (alpha subunit).	LEV-1 is required for normal locomotion, regulation of egg-laying behavior. When mutated, lev-1 confers resistance to levamisole.	Culetto et al, 2004;Gottschalk et al, 2005; Jones et al, 2007
	unc-29 (aka u	*T08G11.5*	nAChR. unc-29 group; non-alpha subunit	**ACh**	Body muscles, the ventral and dorsal cords and in the nerve ring where head muscles are innervated	Forms a ligand-gated cation channel when coexpressed with LEV-1 (non-alpha subunit) and UNC-38 (alpha subunit) or UNC-63 (alpha subunit).	UNC-29 is required for normal locomotion and egg-laying	Fleming et al, 1997; Gottschalk et al, 2005
	acr-2	*K11G12.2*	nAChR. unc-29 group; non-alpha subunit	**ACh**	DA, DB, IL1, PVQ, RMD, VA and VB	Forms a ligand-gated cation channel when coexpressed with the unc-38 (alpha) subunit		Squire et al, 1995; Rand, 2007
	acr-3	*K11G12.7*	nAChR. unc-29 group; non-alpha subunit	**ACh**	Unknown	Forms a ligand-gated cation channel when coexpressed with UNC-38 (alpha) subunit		

unc-38 group	*unc-38*	*F21F3.5*	nAChR. unc-38 group; alpha subunit	**Ach**	Ventral and dorsal nerve cords, many neurons, body wall muscles, vulval and (male) sex muscles, including the protractor muscles. UNC-38 is expressed postsynaptically in muscles and neurons where it colocalizes with TAX-6, and with ACR-8, ACR-12, and UNC-29, respectively	Forms a ligand-gated cation channel when coexpressed with ACR-2, ACR-3, UNC-29, and LEV-1 (non-alpha nAChR subunits)	Required for normal locomotion and egg-laying, and functions as a subunit of a ligand-gated cation channel that likely mediates fast actions of acetylcholine at neuromuscular junctions and in the nervous system. ACR-12 colocalizes with some, but not all, UNC-38-containing postsynaptic receptor clusters, suggesting that ACR-12 contributes to only a subset of these receptor clusters	Baylis et al, 1997; Mongan et al, 2002; Schafer, 2002; Gottschalk et al, 2005
	acr-6	*ZK973.5*	nAChR. unc-38 group; alpha subunit	**Ach**			Predicted to function in regulation of fast neurotransmission	
	unc-63 (aka le	*Y110A7A.3*	nAChR. unc-38 group; alpha subunit	**Ach**	Body wall muscles, vulval muscles, and a large number of neurons including motor neurons in the ventral nerve cord (AS, DA, DB, VB, VD, VC) and neurons in the head, posterior lateral, preanal, and lumbar ganglia. No expression is observed either in the sphincter muscle or in the anal depressor muscle.	Forms a ligand-gated cation channel when coexpressed with UNC-29 and LEV-1 (non-alpha nAChR subunits)	Required for normal locomotion and regulation of egg-laying behavior	Mongan et al, 2002; Culetto et al, 2004; Schafer, 2002
acr-16 group	*acr-7*	*T09A5.3*	nAChR. acr-16 group; alpha subunit	**Ach**	Pharyngeal muscle and in tail neurons distal to the anus	Encodes an alpha-7-like homomer-forming subunit of the nicotinic acetylcholine receptor (nAChR) superfamily		
	acr-9	*C40C9.2*	nAChR. acr-16 group; non-alpha subunit	**Ach**	Unknown			
	acr-10	*R02E12.8*	nAChR. acr-16 group; alpha subunit	**Ach**	Unknown	Encodes an alpha-7-like homomer-forming subunit of the nicotinic acetylcholine receptor (nAChR) superfamily		
	acr-11	*D2092.3*	nAChR. acr-16 group; alpha subunit	**Ach**	Unknown			
	acr-14	*T05C12.2*	nAChR. acr-16 group; non-alpha subunit	**Ach**	AIY, other head neurons, AS, DA, DB, DD, HSN, VB, VC4, VC5, muscle, intestine			Fox et al, 2005; von Stetina et al, 2007; Rand, 2007
	acr-15	*F25G6.4*	nAChR. acr-16 group; alpha subunit	**Ach**	AVA, AVB, DVA, I5, RID, RIM, PVQ, SAA, SIA, SIB, SMB (?), SMD, all ventral cord motor neurons except DD, some unidentified neurons in the head. Also expressed in head muscles (weak), body wall muscles (weak).			Feng et al, 2006; von Stetina et al, 2007
Orthologous to human nicotinic cholinergic receptor alpha 7	*acr-16*	*F25G6.3*	nAChR. acr-16 group; alpha subunit	**Ach**	Subset of neurons; AVA, RIB, RID, SIB, SMD, CEP(?), ADE(?), DB motor neurons and some unidentified neurons in the head and tail. Also expressed in anal depressor, head muscles (strong), body wall muscles (strong; localizes to the tips of muscle arms, specific regions of the muscle cell membrane that form synapses with neuronal processes), but not vulval muscles		ACR-16 functions as a ligand-gated ion channel that is required for the major fast cholinergic excitatory current at C. elegans neuromuscular junctions. When expressed in Xenopus ooctyes, ACR-16 is active as a homomeric receptor and responds robustly to acetylcholine	Francis et al, 2005; Touroutine et al, 2005; Feng et al, 2006
	acr-19	*C31H5.3*	nAChR. acr-16 group; alpha subunit	**Ach**	Unknown			
	acr-21	*F27B3.2*	nAChR. acr-16 group; alpha subunit	**Ach**	Unknown	ACR-21 is a highly divergent member of the 'ACR-16' class of nAChR subunits		
	acr-25	*Y73B6BL.42*	nAChR. acr-16 group; non-alpha subunit	**Ach**	Unknown			Jones and Sattelle, 2004; Jones et al, 2007
	eat-2	*Y48B6A.4*	nAChR. acr-16 group; non-alpha subunit	**Ach**	pm4 and pm5. EAT-2::GFP fusion protein is localized to small dots near the junction of pharyngeal muscles pm4 and pm5	Ligand-gated ion channel subunit most closely related to the non-alpha-subunits of nicotinic acetylcholine receptors (nAChR)	Functions postsynaptically in pharyngeal muscle to regulate the rate of pharyngeal pumping; EAT-2 is also required for normal life span and defecation; a functional EAT-2::GFP fusion protein localizes to two small dots near the junction of pharyngeal muscles pm4 and pm5, which is the site of the posteriormost MC motor neuron processes and the MC synapse; eat-2 genetically interacts with eat-18, which encodes a predicted transmembrane protein expressed in pharyngeal muscle and required for proper function of pharyngeal nicotonic receptors.	McKay et al, 2004
acr-8 group (nematode-specific)	*acr-8*	*ZC504.2*	nAChR. acr-8 group; alpha subunit	**Ach**	All bodywall muscles, anal and vulval muscles, ventral cord motor neurons (punctate sites along nerve cords), head neurons and nerve ring processes, and in tail neurons			
	acr-12	*R01E6.4*	nAChR. acr-8 group; alpha subunit	**Ach**	Ventral cord motor neurons, multiple neuro		ACR-12 is predicted to mediate fast excitatory neurotransmission, however loss of acr-12 activity via mutation or RNAi results in no obvious defects. ACR-12 copurifies with UNC-29 and LEV-1, suggesting that ACR-12 can form receptors with these two non-alpha AChR subunits. ACR-12 colocalizes with some, but not all, UNC-38-containing postsynaptic receptor clusters, suggesting that ACR-12 contributes to only a subset of these receptor clusters	Gottschalk et al, 2005
	acr-13 (lev-8)	*C35C5.5*	nAChR. acr-8 group; alpha subunit	**Ach**	Expression of a LEV-8::GFP reporter construct begins at the L1 larval stage. Expression is detected in body wall muscles, uv1 and uv2 uterine muscles, anal depressor muscle, and neurons, including PVT, ALA, many ventral cord neurons, including all DD cells, many head neurons, IL and OL socket cells		Required for normal rates of pharyngeal pumping and for fully wild-type responses (increased egg laying and body wall muscle contraction) to the nAChR agonist and antihelmintic levamisole	Towers et al, 2005; Gottschalk et al, 2005
deg-3 group (nematode-specific)	*deg-3*	*K03B8.9*	nAChR. deg-3 group; alpha subunit	**ACh**	Consistent with their role in metabolite chemosensation, DEG-3 and DES-2 are expressed in nonsynaptic regions such as the sensory endings of the IL2 chemosensory neurons; DEG-3 and DES-2 are also detected in the touch cell neurons (ALM, AVM, PLM), anterior head muscles, AVG, PVD, PVC, FLP	DEG-3 can form heteromeric channels with a second alpha subunit, DES-2, and in vivo these channels appear to be required for chemosensation of choline; deg-3 and des-2 reside in an operon, and consistent with their role in metabolite chemosensation, are expressed in nonsynaptic regions such as the sensory endings of the IL2 chemosensory neurons	Originally defined by a gain-of-function mutation that results in neuronal degeneration and uncoordinated movement	Treinin et al, 1998; Yassin et al, 2001
	acr-4 (des-2)	*T26H10.1*	nAChR. deg-3 group; alpha subunit	**Ach**	Consistent with their role in metabolite chemosensation, DEG-3 and DES-2 are expressed in nonsynaptic regions such as the sensory endings of the IL2 chemosensory neurons; DEG-3 and DES-2 are also detected in the touch cell neurons (ALM, AVM, PLM), anterior head muscles, AVG, PVD, PVC, FLP. Also expressed in ALA	DEG-3 can form heteromeric channels with a second alpha subunit, DES-2, and in vivo these channels appear to be required for chemosensation of choline; deg-3 and des-2 reside in an operon, and consistent with their role in metabolite chemosensation, are expressed in nonsynaptic regions such as the sensory endings of the IL2 chemosensory neurons		Treinin et al, 1998; van Buskirk and Sternberg, 2010
	acr-5	*K03F8.2*	nAChR. deg-3 group; alpha subunit	**Ach**	Expressed exclusively in the nervous syste			Winnier et al, 1999
	acr-17	*F53E10.2*	nAChR. deg-3 group; alpha subunit	**ACh**	Unknown			Mongan et al, 2002; Sattelle et al, 2002; Schafer, 2002
	acr-18	*F28F8.1*	nAChR. deg-3 group; alpha subunit	**ACh**	Unknown			Mongan et al, 2002; Sattelle et al, 2002; Schafer, 2002
	acr-20	*R06A4.10*	nAChR. deg-3 group; alpha subunit	**ACh**	Unknown			
	acr-23	*F59B1.9*	nAChR. deg-3 group; alpha subunit	**ACh**	Unknown			
	acr-24	*Y73F8A.30*	nAChR. deg-3 group; alpha subunit	**Ach**	Unknown			Jones and Sattelle, 2004; Jones et al, 2007
Ungrouped	*lgc-11 (acr-22,*	*F48E3.7*	Ligand-gated ion channel of the cys-loop superfamily with sequence similarity to nicotinic acetylcholine receptor subunits, including the vertebrate neuronal acetylcholine receptor alpha-9 subunits	**Ach**	Unknown	.		Mongan et al, 2002; Jones et al, 2007; Jones and Sattelle, 2008
	acc-1	*F58G6.4*	Acetylcholine-gated chloride channel (not found in vertebrates)	**Ach**	Unknown			Putrenko et al, 2005
	acc-2	*C53D6.3*	Acetylcholine-gated chloride channel (not found in vertebrates)	**Ach**	Unknown			Putrenko et al, 2005
	acc-3	*F55D10.5*	Acetylcholine-gated chloride channel (not found in vertebrates)	**Ach**	Unknown			Putrenko et al, 2005
	acc-4	*T27E9.9*	Acetylcholine-gated chloride channel (not found in vertebrates)	**Ach**	Unknown			Putrenko et al, 2005
	lgc-46	*Y71D11A.5*	Ligand-gated ion channel (acc-1 group)					Jones and Sattelle, 2008
	lgc-47	*F47A4.1*	Ligand-gated ion channel (acc-1 group)					Jones and Sattelle, 2008

	lgc-48	*C50B6.11*	Ligand-gated ion channel (acc-1 group)					Jones and Sattelle, 2008
	lgc-49	*K10D6.1*	Ligand-gated ion channel (acc-1 group)					Jones and Sattelle, 2008
	cup-4	*C02C2.3*	Non-alpha ligand-gated ion channel with similarity to the nicotinic acetylcholine receptors	**Ach ?**	Coelomocytes. Localizes primarily to vesicles scattered around the cytoplasm. While some of the CUP-4::GFP localized around the nucleus, presumably in the endoplasmic reticulum (ER) membrane, the general pattern of localization of CUP-4::GFP was quite distinct from that of cytochrome b5, a marker for smooth ER, and from TRAM, a marker for the rough ER.hese results are consistent with CUP-4::GFP localizing at steady state to the Golgi apparatus or to the plasma membrane/endosomes.		Required cell autonomously for efficient fluid endocytosis in coelomocytes; cup-4 mutant animals display reduced levels of plasma membrane phosphatidylinositol 4,5-bisphosphate, suggesting that CUP-4 may regulate endocytosis via regulation of phospholipase C activity; in addition, cup-4 mutants display disorganized clathrin and RME-1 at the coelomocyte plasma membrane	Fares and Greenwald, 2001; Jones and Sattelle, 2004; Patton et al, 2005
	lgc-31	*F21A3.7*	nAChR? Ligand-gated ion channel	**Ach ?**				Jones and Satelle, 2008

Homolog/ Ortholog	**C. elegans gene**	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**
GABA (gamma-aminobutyric acid)								
Receptors								
GABA-AR	*unc-49*	*T21C12.1*	Ligand-gated anion (chloride) channel	**GABA**	Dorsal and ventral head and body wall muscles on both the dorsal and ventral sides (localized in postsynaptic terminals at the NMJs). Isoform-specific expression also seen in the anal sphincter muscle (unc-49B::gfp but not unc-49C::gfp animals). Variable, weak fluorescence in head ganglia		Encodes multiple subunits of a heteromeric GABA receptor. There are 9 cDNA-confirmed or partially-confirmed isoforms (T21C12.1a-T21C12.1i). UNC-49 activity is required for postsynaptic GABA responsiveness, and thus, for normal regulation of locomotion	Bamber et al, 1999; Jorgensen, 2005; Jones et al, 2008
	lgc-36	*F07B10.5*	Ligand-gated ion channel (unc-49 group)					Jones and Satelle, 2008
Human gamma-aminobutyric acid A receptor gamma 2 (GABRG2)	*lgc-37*	*ZC482.5*	Ligand-gated ion channel (unc-49 group)		All of the touch receptor neurons (ALM, AVM, PLM), ventral cord motor neurons, and many neurons in the head and some in the tail.			Jones and Satelle, 2008; Topalidou and Chalfie, 2011
	lgc-38	*F11H8.2*	Ligand-gated chloride channel	**GABA**	AIY			Wenick & Hobert, 2004; Jones and Satelle, 2008
	gab-1 (gbr-1)	*ZC482.1*	A GABA receptor beta-like subunit with both the neurotransmitter-gated ion-channel ligand binding and transmembrane domains	**GABA**	All touch receptor neurons (ALM, AVM, PLM), ventral cord motor neurons, and many neurons in the head and some in the tail.	GAB-1 can form a GABA-responsive channel when co-expressed with alpha/gamma type subunits in a heterologous expression system	Involved in the mechanism of resistance to the widely used broad-spectrum anthelmintic drug Ivermectin	Feng et al, 2002; Topalidou and Chalfie, 2011
	ggr-1 (gbr-4)	*C09G5.1*	Ligand-gated chloride channel (a predicted member of the GABA/glycine receptor family of ligand-gated chloride channels)	**GABA**	AIB, AVH, PVR, PVQ, and SMDV neurons and in some motor neurons in the ventral cord, and in the egg-laying muscles		Affects thermotaxis.	
	ggr-2 (gbr-5)	*C45B2.4*	Ligand-gated chloride channel (a predicted member of the GABA/glycine receptor family of ligand-gated chloride channels)	**GABA**	CAN, DD, HSN, SIAV, SMDV, SMDD. Egg-laying muscles (weak)		Affects thermotaxis.	
	ggr-3 (gbr-6)	*F09C12.1*	Ligand-gated chloride channel (a predicted member of the GABA/glycine receptor family of ligand-gated chloride channels)	**GABA**	AVA, AVB, DVA, SIAD, SMDD, and in some			
	lgc-39	*F09G2.5*	Ligand-gated ion channel (ggr-1 group)					Jones and Satelle, 2008
	lgc-40	*T24D8.1*	Ligand-gated ion channel (ggr-1 group)					Jones and Satelle, 2008
	lgc-41	*C39B10.2*	Ligand-gated ion channel (ggr-1 group)					Jones and Satelle, 2008
	lgc-42	*Y39A3B.2*	Ligand-gated ion channel (ggr-1 group)					Jones and Satelle, 2008
	lgc-51	*F12B6.3*	Ligand-gated ion channel (ggr-3 group)					Jones and Satelle, 2008
	lgc-52	*Y73F8A.2*	Ligand-gated ion channel (ggr-3 group)					Jones and Satelle, 2008
	lgc-53	*T21F2.1*	Ligand-gated ion channel (ggr-3 group)					Jones and Satelle, 2008
	lgc-54	*T15B7.16*	Ligand-gated ion channel (ggr-3 group)					Jones and Satelle, 2008
	exp-1	*H35N03.1*	Excitatory, cation-selective GABA receptor	**GABA**	Intestinal and anal depressor muscles (it localizes to regions consistent with the positions of neuromuscular junctions), neurons, including ADE, PDA, RID and SABD	When expressed in Xenopus oocytes, EXP-1 is capable of forming a cation-selective GABA receptor	Essential for the enteric muscle contractions that are the third in a series of three independent muscle contractions controlling defecation	Thomas, 1990; Beg and Jorgensen, 2003
	lgc-35	*Y46G5A.26*	Ligand-gated ion channel (exp-1 group)	**GABA**	Unknown			Jones and Satelle, 2008
GABA-BR								
human GABBR1	*gbb-1*	*Y41G9A.4*	GPCR. Metabotropic GABA receptor. Encodes, by alternative splicing, one isoform of a subunit of the GABAB receptor dimer (Y41G9A.4/ZK180.1, or 'GBB-1/2').	**GABA**	Unknown		Required for inhibition of cholinergic motor neurons by GABA, and thus for normally restrained movement and aldicarb resistance. Y41G9A.4/gbb-1(tm1406) mutants move abnormally fast, with abnormally few changes of direction	Dittman and Kaplan, 2008; Vashlishan et al, 2008
	gbb-2	*ZK180.1*	GPCR. Metabotropic GABA receptor. Encodes a subunit of the GABAB receptor dimer (Y41G9A.4/ZK180.1, or 'GBB-1/2'). orthologous to human GABBR2	**GABA**	Unknown		Required for inhibition of cholinergic motor neurons by GABA, and thus for normally restrained movement and aldicarb resistance. ZK180.1/gbb-2'(tm1165) mutants move abnormally fast, with abnormally few changes of direction	Dittman and Kaplan, 2008; Vashlishan et al, 2008

Homolog/ Ortholog	***C. elegans* gene**	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**
GLYCINE								
Receptors								
	lgc-34	*T27A1.4*	Ligand-gated anion (chloride) channel	**Glycine**				Jones et al, 2007; Jones and Satelle, 2008
GLUTAMATE								
Receptors								
Metabotropic glutamate receptors (mGluRs)							The metabotropic glutamate receptors are a family of G protein-coupled receptors, that have been divided into 3 groups in higher organisms on the basis of sequence homology, putative signal transduction mechanisms, and pharmacologic properties. Group I includes GRM1 and GRM5 and these receptors have been shown to activate phospholipase C. Group II includes GRM2 and GRM3, while Group III includes GRM4, GRM6, GRM7 and GRM8. Group II and III receptors are linked to the inhibition of the cyclic AMP cascade but differ in their agonist selectivities. The metabotropic glutamate receptors mediate relatively slow glutamate responses.	Tanabe, 1992
	mgl-1	*ZC506.4*	mGluR. A Group II metabotropic glutamate receptor. GPCR superfamily.	**Glutamate**	AIA, AIY, RMDV, RMDD and NSM		MGL-1 is required for normal post-embryonic growth rates. MGL-1 is predicted to function as a pre-synaptic G protein-coupled receptor that, in response to glutamate binding, inhibits adenylyl cyclase activity	Wenick and Hobert, 2004; Greer ER et al, 2008

	mgl-2	*F45H11.4*	mGluR. A Group I metabotropic glutamate receptor. GPCR superfamily.	**Glutamate**	Interneurons		MGL-2 is predicted by homology, to function as a post-synaptic G protein-coupled receptor that, in response to glutamate binding, stimulates phospholipase C activity and increases neuronal excitation (in mammalian tissue culture cells, glutamate stimulation of MGL-2 does result in increased phosphoinositide turnover). A mutation in mgl-2 indicates that it is required for normal head movements and tap reversal reflexes, while loss of mgl-2 activity via large-scale RNAi screens indicates that MGL-2 is also required for embryogenesis.	
	mgl-3	*Y4C6A.2*	mGluR. Related to glutamate-gated metabotropic ion channel receptor subunit GRM2 and related subunits	**Glutamate**	NSM, ADF, ASE, and AWC amphid sensory neurons, and the RIB and RIC interneurons, occasionally in BAG neurons	Related to glutamate-gated metabotropic ion chann		Greer et al., 2008
		F35H10.10	mGluR. Related to glutamate-gated metabotropic ion channel receptor subunit GRM2 and related subunits.	**Glutamate?**	Unknown	Related to glutamate-gated metabotropic ion chann		
Ionotropic glutamate receptors (iGluRs)								Tanabe, 1992
The anion (Cl-)-specific ionotropic glutamate receptors								
	glc-1	*F11A5.10*	iGluR. Ligand-gated anion (chloride) channel; alpha subunit of a glutamate-gated chloride channel	**Glutamate**	Unknown	Encodes the alpha subunit of a glutamate-gated chloride channel and forms a functional channel in Xenopus oocytes		Cully et al, 1994; Etter et al, 1999; Dent et al, 2000
	glc-2 (avm-2)	*F25F8.2*	iGluR. Beta subunit of a glutamate-gated chloride channel	**Glutamate**	pm4 pharyngeal muscles of larvae and adults	GLC-2 is capable of forming homomeric glutamate-activated channels, as well as heteromeric channels with GLC-1 that can be activated by glutamate and avermectins, antihelmintics that inhibit pharyngeal pumping.	Loss of glc-2 activity via large-scale RNAi screens does not result in any obvious abnormalities, hence, the precise role of GLC-2 in development and/or behavior is not yet known. However, GLC-2 may have a role in regulation of glutamatergic inhibition of pharyngeal pumping	Cully et al, 1994; Laughton et al, 1997; Yates et al, 2003
	glc-3	*ZC317.3*	iGluR. Fipronil and BIDN-sensitive, but picrotoxinin-insensitive, L-glutamate-gated chloride channel subunit	**Glutamate**	AIY and other head neurons		The inhibitory, glutamatergic synapses between AWC neuron and AIA and AIY neurons are via GLC-3. This glutamate signaling pathway between AWC-AIA promotes local search and odor chemotaxis. These responses are modulated (limited) by NLP-1/NPR-11 signaling between AWC and AIA.	Horoszok et al, 2004; Wenick and Hobert, 2004; Chalasani et al., 2007; Chalasani et al., 2010
	glc-4	*C27H5.8*	iGluR. A predicted glutamate-gated chloride channel	**Glutamate**	Unknown		Affects ivermectin sensitivity and reversal behavior and genetically interacts with avr-14	
human GLRA-2	*avr-14 (gbr-2)*	*B0207.12*	iGluR. Alpha-type subunit of a glutamate-gated chloride channel	**Glutamate**	Expressed exclusively in a subset of 40 sor	Encodes a glutamate-gated chloride channel alpha-type subunit homolog	Affects sensitivity to the antiparasitic drug, ivermectin, in parallel with AVR-15 and GLC-1 and in a genetic pathway with unc-9. Functions in the extrapharyngeal nervous system	Culetto and Sattelle, 2000; Dent et al, 2000
	avr-15	*R11G10.1*	iGluR. Alpha-type subunit of a glutamate-gated chloride channel	**Glutamate**	pm4, pm5 (precisely those muscles onto which M3 synapses; expression begins shortly before hatching and persists throughout adulthood), a few neurons of the head, including RMED, RMEV and RMGs, DA9 and possibly VA12. Some unidentified neurons contributing to the dorsal and ventral sublateral nerve cords.	Encodes two glutamate-gated chloride channel alpha-type subunit homologs via alternative splicing. When expressed heterologously in Xenopus oocytes, AVR-15a forms a homomeric channel that is ivermectin-sensitive and glutamate-gated.	The alternative splice products mediate fast inhibitory glutamatergic neuromuscular transmission, as well as ivermectin sensitivity, and are required for normal pharyngeal function (mutation of avr-15 alone renders animals slightly starved and induces an abnormal electropharyngeogram, implying that AVR-15a/b are nonredundant in pm4 and pm5, onto which M3 synapses. AVR-15a is necessary postsynaptically for a functional M3 synapse and for the hyperpolarizing effect of glutamate on pharyngeal muscle. Simultaneous mutation of avr-14, avr-15, and glc-1 confers high-level resistance to the antiparasitic drug ivermectin, while resistance remains low with mutations in avr-15 alone; this implies that these genes (which all encode glutamate-gated chloride channel alpha-type subunit homologs) have somewhat redundant products for ivermectin resistence	Dent et al, 1997; Dent et al, 2000
The cation-specific ionotropic glutamate receptors							The cation-specific ionotropic glutamate receptors are subdivided into alpha-amino-3-hydroxy-5-methyl-4-isoxazole propionate (AMPA)/Kainate receptors and N-methyl--D-Aspartate (NMDA) receptors. Activation of NMDA receptors results in the opening of an ion channel that is nonselective to cations. A unique property of the NMDA receptor is its voltage-dependent activation, a result of ion channel block by extracellular Mg++ ions. This allows voltage-dependent flow of Na+ and small amounts of Ca++ ions into the cell and K+ out of the cell	Brockie and Maricq, 2006
	glr-1 (not-3)	*C06E1.4*	iGluR. AMPA (non-NMDA)-type ionotropic (Na+/K+) glutamate receptor subunit	**Glutamate**	Motor neurons and command interneurons		GLR-1 activity is required for mediating the behavioral response to light nose touch and the frequency with which animals change locomotory direction in response to sensory cues such as food; GLR-1 and GLR-2 can interact to form functional heteromeric channels. GLR-1 localizes to perinuclear structures in cell bodies and to punctate structures that appear to be glutamatergic postsynaptic specializations. Proper GLR-1 localization in the anterior ventral nerve cord of older larvae and adults requires activity of the class I PDZ protein LIN-10. GLR-1 is ubiquitinated in vivo and its abundance at postsynaptic elements, which may influence postsynaptic strength, is regulated by ubiquitination. GLR-1 trafficking in interneurons has been shown to be regulated by the UEV-1 ubiquitin-conjugating enzyme variant and the UBC-13 ubiquitin-conjugating enzyme.	Maricq et al, 1995; Rongo et al, 1998; Brockie et al, 2001; Hills et al, 2004
	glr-2	*B0280.12*	iGluR. AMPA (non-NMDA)-type ionotropic (Na+/K+) glutamate receptor subunit	**Glutamate**	Command interneurons AVA, AVD, AVE, PV		GLR-2 activity is required for mediating the behavioral response to light nose touch and for regulating the frequency with which animals change locomotory direction in response to sensory cues such as food. GLR-2 and GLR-1 can interact to form functional heteromeric channels.	Brockie et al, 2001; Aronoff et al, 2004
human GRIK2	*glr-3*	*K10D3.1*	iGluR. Ligand-gated ion channel. similar to kainate-selective ionotropic glutamate receptor 2 (human GRIK2)	**Glutamate**	RIA (thermosensory interneron)			Brockie et al, 2001
	glr-4	*C06A8.9*	iGluR. (non-NMDA)-type	**Glutamate**	AUA, AVA (faint), AVH, DVA, DB(?), FLP, F	Encodes a putative non-NMDA ionotropic glutamate receptor subunit, most closely related to GLR-3 and less so to GLR-7, possibly of the kainate subfamily.	*glr-4 expression requires UNC-42, as well as CFI-1 in URA cells.*	Brockie et al, 2001; Sprengel at al, 2001; Shaham and Bargmann, 2002
	glr-5	*ZC196.7*	iGluR. Kainate (non-NMDA)-type	**Glutamate**	AIB (?), AVA, AVB, AVD, AVE, AVK, DVA (?)		GLR-5 activity is required for normal brood sizes, especially at high temperatures	Brockie et al, 2001
	glr-6	*F14B4.4*	iGluR. (non-NMDA)-type	**Glutamate**	RIA (thermosensory interneron)	Encodes a putative non-NMDA ionotropic glutamate receptor subunit, most closely related to GLR-5, possibly of the kainate subfamily		Brockie et al, 2001; Sprengel et al, 2001
	glr-7	*C43H6.9*	iGluR. (non-NMDA)-type	**Glutamate**	I1(?), I2, I3, I6, MI, NSM			Brockie et al, 2001
	glr-8	*F22A3.3*	iGluR. Unclassifiable as NMDA or non-NMDA (though possibly of the delta subfamily) receptor subunit	**Glutamate**	ALM, BDU, I1, I2, I3, I6, MI, M3, M4, M5, M	Encodes a highly divergent putative ionotropic glutamate receptor subunit, unclassifiable as NMDA or non-NMDA (though possibly of the Delta subfamily), and without any clear close homologs in metazoa or plants		Brockie et al, 2001; Sprengel et al, 2001
	nmr-1	*F07F6.6*	iGluR. NMDA-type ionotropic glutamate receptor subunit	**Glutamate**	AVA, AVD, AVE, AVG, PVC, RIM and in oocytes and sheath cells		Affects the duration of forward movement which is important during foraging behavior; the slow kinetics typical of NMDA-dependent currents are likely important for its effect on forward movement. Also affects osmotic avoidance	Brockie et al, 2001; Mellem et al, 2002
	nmr-2	*T01C3.10*	iGluR. NMDA-type ionotropic glutamate receptor subunit. Most similar to members of the NR2A subfamily of the NMDA class of iGluRs	**Glutamate**	AVA, AVD, AVE, AVG, PVC and RIM interne		Required for full memory retention of a learned avoidance behavior, namely avoidance of NaCl after starvation conditioning. Additionally, NMR-2 activity is required for NMDA-gated currents in the AVA interneuron. nmr-2 expression in AVA and AVE is positively regulated by the FAX-1 nuclear receptor	Brockie et al, 2001; Wightman et al, 2005; Kano et al 2008
GluR Regulatory proteins								
TARPs (TARPs are obligate auxiliary subunits for AMPARs with a primary, evolutionarily conserved functional role in the modification of current kinetics)	*stg-1*	*C18D1.4*	One of two transmembrane AMPA receptor Regulatory Proteins (TARPs) in C. elegans.		Most of the interneurons that express nmr-1 also appear to express both stg-1 and stg-2, with the notable exception of the AVA. stg-2, but not stg-1, is strongly expressed in AVA. There is considerable overlap in stg-1 and stg-2 expression patterns. stg-1 is expressed in the nervous system, with expression apparent in most of the neurons that normally express the GLR-1 subunit. GLR-1 and STG-1 colocalize at the tips of muscle arms.	Encodes a claudin homolog that may regulate ion channels (claudins are integral membrane proteins with four transmembrane sequences that are found in mammalian tight junctions (TJs), induce TJs when transgenically expressed in cells normally lacking them, and can mediate the specific conductance of of specific ions (e.g., magnesium or calcium) through TJs while blocking the flow of water)	STG-1 is similar to mammalian voltage-dependent calcium channel gamma subunits that are known or suspected to prevent epilepsy in vivo, however, C18D1.4 has no obvious function in mass RNAi assays	Walker et al, 2006; Wang et al, 2008

	stg-2	*F12D9.1*	One of two transmembrane AMPA receptor Regulatory Proteins (TARPs) in C elegans		Most of the interneurons that express nmr-1 also appear to express both stg-1 and stg-2, with the notable exception of the AVA. stg-2, but not stg-1, is strongly expressed in AVA. There is considerable overlap in stg-1 and stg-2 expression patterns.			Walker et al, 2006; Wang et al, 2008
Function unknown								
	lgc-32	T19D7.1	Ligand-gated ion channel			Encodes a highly divergent member of the cys-loop ligand-gated ion channel (LGIC) superfamily		Jones and Satelle, 2008
	lgc-33	Y55F3BR.4	Ligand-gated ion channel					Jones and Satelle, 2008
	lgc-43	C43F9.9	Ligand-gated ion channel (LGC-45 group)					Jones and Satelle, 2008
	lgc-44	F46F3.2	Ligand-gated ion channel (LGC-45 group)					Jones and Satelle, 2008
	lgc-45	W10G11.16	Ligand-gated ion channel (LGC-45 group)					Jones and Satelle, 2008
	M03F8.6	*M03F8.6*	Neurotransmitter-gated ion-channel?					
Supplementary Information								
G proteins in C. elegans							There are a total of 21 C. elegans Ga subunits; each of the four subfamilies of Ga proteins found in mammals is represented by one C. elegans ortholog: Gao/i:GOA-1; Gaq: EGL-30; Gas:GSA-1 and Ga12: GPA-12. The remaining 17 have no obvious mammalian orthologs. These are expressed exclusively in sensory neurons and function in chemosensation. There are two Gb subunits; Gb1-4: GPB-1 and Gb5: GPB-2. There are two Gg subunits: GPC-1 and GPC-2.	Porter and Koelle, 2009

Homolog/ Ortholog	**C. elegans gene**	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**
NEUROPEPTIDE/NEUROHORMONE RECEPTORS				**See [Li and Kim, 2008] and [Frooninckx et al, 2012] for ligand peptide sequences**				Li and Kim, 2008; Frooninckx et al, 2012
Class A/Rhodopsin Family of GPCRs								
Neuropeptide Y (npr)/RFamide receptors group						Class A Rhodopsin family-Group IIIB		Keating et al., 2003
Mammalian neuropeptide Y (NPY) receptor	*npr-1*	*C39E6.6*	Homologous to the mammalian neuropeptide Y (NPY) receptor	**flp-18 and flp-21-encoded peptides**	AQR, PQR, and URX neurons that are exposed to the body fluid, ASE, ASG, ASH (L4/adult stages only), URX, IL2L/R and OLQ (with its socket and sheath cells), the interneurons AUA and SAAD, the motor neurons RMG and SMBD, and the pharyngeal neuron M3	Encodes a predicted G protein-coupled neuropeptide receptor that is homologous to the mammalian neuropeptide Y (NPY) receptor required for regulating anxiety, food consumption, and pain sensation	NPR-1 is involved in naturally occurring variations of social behavior such as social versus solitary feeding; social C. elegans strains (e. g., RC301 and CB4932) move rapidly on a patch of bacterial food, accumulate on the borders of the food patch (bordering), and cluster in tight little swarms when feeding (aggregation). Solitary strains (e. g., N2), by contrast, move slowly on food, show no preference for the borders and feed alone (they only clump when food is sparse). These three behaviors are coordinately controlled by NPR-1. Solitary strains express a high-activity form of NPR-1 (215V allele), whereas social feeders express a low-activity version (215F allele). npr-1 null mutants are also social. In regulating social behavior, NPR-1 functions as a receptor for the FLP-18 and FLP-21 peptide ligands. //NPR-1 also affects some aspect of UNC-6/netrin-mediated branching of motor neurons, as strong npr-1 mutations can suppress abnormal migration of ventral nerve cord neurons induced by overexpression of UNC-6 lacking domain C. //NPR-1 functions to suppress innate immune responses and this function requires TAX-2 and TAX-4 as well as GCY-35.	Coates and de Bono 2002; Kubiak et al, 2003a; Rogers et al, 2003; Lockery, 2009, Styer et al., 2008
	npr-2	*T05A1.1a&b*					Deletions in four receptors (npr-2, npr-4, npr-5, and npr-7) were found to be associated with increased intestinal fat storage compared to wild-type animals. Likely involved in locomotion.	Keating et al., 2003
C-X-C chemokine receptor type 3 (CXC-R3)	*npr-3*	*C10C6.2*	aka FLP-15R. C10C6.2 is primarily coupled to Gi/Go proteins, since C10C6.2 signalling is blocked by pertussis toxin	**FLP-15-1 and FLP-15-2**	Ventral nerve cord; both excitatory and inhibitory motor neurons		Likely involved in locomotion. Because of its link to Gi/Go proteins, C10C6.2 is expected to be inhibitory.	Keating et al., 2003; Kubiak et al., 2003b; Cohen et al., 2009
	npr-7	*F35G8.1*					Deletions in four receptors (npr-2, npr-4, npr-5, and npr-7) were found to be associated with increased intestinal fat storage compared to wild-type animals. Likely has a role in reproduction.	Keating et al., 2003; Cohen et al., 2009
	npr-8a&b	*C56G3.1*						Cohen et al., 2009
	npr-10a&b	*C53C7.1*		**FLP-3-1, FLP-3-3, FLP-3-5, FLP-3-6, FLP-3-7, FLP-3-8, FLP-18-1, FLP-18-3, FLP-18-4, FLP-18-5, FLP-18-6**				Frooninckx et al, 2012
	npr-11	*C25G6.5*		**FLP-1-6, FLP-5-2, FLP-14, FLP-18-3, FLP-21, NLP-1**	AIA, AIY		The function of the inhibitory, glutamatergic synapse between AWC neuron and AIA neuron via GLC-3 is acutely modulated by NLP-1/NPR-11 signaling (this synapse is important in local search behavior and chemotaxis/odor adaptation). Also likely involved in reproduction.	Keating et al., 2003; Chalasani et al., 2010; Frooninckx et al, 2012
	npr-12	*T22D1.12*					Reproduction	Frooninckx et al, 2012
	npr-13	*ZC412.1*						
Human Galanin receptor type 1		*Y54E2A.1*						Cohen et al., 2009
	npr-4	*C16D6.2*		**FLP-1-6, FLP-4-2, FLP-18-1, FLP-18-2, FLP-18-3, FLP-18-4, FLP-18-5, FLP-18-6**	AVA, RIV, PQR, BDU, possibly BAG, coelomocytes, parts of the intestine, rectal gland cells		Involved in regulation of fat accumulation; deletions in four receptors (npr-2, npr-4, npr-5, and npr-7) were found to be associated with increased intestinal fat storage compared to wild-type animals. Involved in regulation of olfaction and foraging. Likely involved in reproduction.	Keating et al., 2003; Cohen et al., 2009; Frooninckx et al, 2012
	npr-5a&b	*Y58G8A.4*		**NPR-5a: FLP-1-2, FLP-3-1, FLP-3-3, FLP-3-6, FLP-3-8, FLP-18-1, FLP-18-2, FLP-18-3, FLP-18-4, FLP-18-5, FLP-18-6, FLP-21; NPR-5b: FLP-1-2, FLP-3-1, FLP-3-3, FLP-3-6, FLP-3-8, FLP-4-2, FLP-18-1, FLP-18-2, FLP-18-3, FLP-18-4, FLP-18-5, FLP-18-6, FLP-21**	ADF, ASE, ASG, ASI, ASJ, ASK, AWA, AWB, IL2, AIA, LUA, PHA, PHB, head muscles, neck muscles, body muscles		Involved in regulation of fat accumulation; deletions in four receptors (npr-2, npr-4, npr-5, and npr-7) were found to be associated with increased intestinal fat storage compared to wild-type animals. Involved in regulation of dauer formation.	Kubiak et al., 2008; Cohen et al., 2009; Frooninckx et al, 2012
	npr-6	*F41E7.3*		**FLP-18-3, FLP-18-6, FLP-21**			Likely involved in reproduction.	Keating et al., 2003
	frpr-1	*C02B8.5*				Encodes a homolog of the functionally active Fmrf Receptor (FR; CG2114) of D. melanogaster; it is thus possible that C02B8.5 is a receptor for one of the FMRF-like neurotransmitters in C. elegans		
	frpr-2	*C05E7.4*						
	frpr-4	*C54A12.2*						

	frpr-3	*C26F1.6*	VRFamideR1	**FLP-7-2, FLP-11-1, FLP-7-1 (inactive), FLP-7-3 (inactive), FLP-7-4 (inactive)**		Encodes a homolog of the functionally active Fmrf Receptor (FR; CG2114) of D. melanogaster	Likely involved in reproduction.	Keating et al., 2003; Mertens et al., 2004; Bendena et al., 2012
	frpr-5a&b	*C56A3.3*				Encodes a homolog of the functionally active Fmrf Receptor (FR; CG2114) of D. melanogaster; it is thus possible that C56A3.3 is a receptor for one of the FMRF-like neurotransmitters in C. elegans		
	frpr-6	*F21C10.12*						
	frpr-8	*F53A9.5*						
	frpr-9a&b	*F53B7.2*				Encodes a homolog of the functionally active Fmrf Receptor (FR; CG2114) of D. melanogaster; it is thus possible that F53B7.2 is a receptor for one of the FMRF-like neurotransmitters in C. elegans		
	frpr-11	*K06C4.8*						
	frpr-12	*K06C4.9*						
	frpr-14	*K07E8.5*				Encodes a homolog of the functionally active Fmrf Receptor (FR; CG2114) of D. melanogaster; it is thus possible that K07E8.5 is a receptor for one of the FMRF-like neurotransmitters in C. elegans		
	frpr-15	*K10C8.2*				Encodes a homolog of the functionally active Fmrf Receptor (FR; CG2114) of D. melanogaster; it is thus possible that K10C8.2 is a receptor for one of the FMRF-like neurotransmitters in C. elegans		
	frpr-16	*R12C12.3*						
	frpr-17	*T14C1.1*				Encodes a homolog of the functionally active Fmrf Receptor (FR; CG2114) of D. melanogaster; it is thus possible that T14C1.1 is a receptor for one of the FMRF-like neurotransmitters in C. elegans		
	frpr-18a&b	*T19F4.1*	aka FLP-2R. T19F4. 1A/B are probably linked to the G(q) pathway	**FLP-2-1 and FLP-2-2**		Encodes, by alternative splicing, two G-protein coupled receptors for the flp-2-encoded peptides	T19F4.1B protein has an extension of 30 residues more than T19F4.1A in the intracellular C-terminal region.	Mertens et al., 2005
	frpr-19	*Y41D4A.8*				Encodes a homolog of the functionally active Fmrf Receptor (FR; CG2114) of D. melanogaster; it is thus possible that Y41D4A.8 is a receptor for one of the FMRF-like neurotransmitters in C. elegans		
	frpr-20	*C30B5.5*	aka daf-37					
		C09F12.3						
Homolog/ Ortholog	**C. elegans gene**	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**
Somatostatin and galanin-like receptors group						Class A Rhodopsin family-Group V		Keating et al., 2003
	npr-9	*ZK455.3*			AIB			Bendena et al., 2008
	npr-16a&b	*F56B6.5*	GPCR that is most similar to the mammalian somatostatin receptors		Head and tail neurons, ventral nerve cord, anal depressor muscle, vulval muscle vm1			Kamath et al., 2003; Wang et al., 2006
	npr-17	*C06G4.5*						
	npr-18a-g	*C43C3.2*						
	npr-24	*R106.2*						
	npr-25	*T02E9.1*					Likely involved in locomotion.	Keating et al., 2003
	npr-26	*T02D1.6*						
	npr-27	*F42C5.2*						
	npr-28	*F55E10.7*						
	npr-29	*ZC84.4*				Encodes a G protein-coupled receptor with acidic amino acids in the -3 position of its PDZ binding motif; ZC84.4 protein binds PDZ domain 10 of the multi-PDZ domain protein, MPZ-1, in GST pulldown experiments; by analogy with SER-1, the PDZ binding motif of ZC84.4 may enhance its signalling		Xiao et al, 2006
	npr-30	*H10E21.2*						
	npr-32	*Y116A8B.5*						
		C17H11.1						
		C24B5.1						
		F57A8.4						
		W10C4.1						
Opioid receptor-like group								
	npr-31	*T07F8.2*	Nociceptin receptor-like					
Tachykinin (Neurokinin) receptor-like group						Class A Rhodopsin family-Group IIIB		Keating et al., 2003
	tkr-1	*C38C10.1*	C. elegans tachykinin-like neuropeptide receptor homolog		Suggested to be expressed in the socket cells of the deirid (ADEso) and post-deirid sensilla (PDEso) from the L2 larval stage through adulthood.		By homology, TKR-1 is predicted to function in modulation of excitatory neurotransmission. As loss of tkr-1 activity via RNAi results in moderate reduction of fat content, TKR-1 may play a specific role in regulating lipid metabolism	Barrett et al., 1996
	npr-14	*W05B5.2*			AIY			Wenick and Hobert, 2004
	npr-15	*T27D1.3*	Similar to arthropod allatostatin receptors		AWC, ASG, ASE. Weak fluorescence was also observed in the ASI and ASJ sensory neurons and four other unidentified head neurons.			Mills et al., 2012
	tkr-3a&b	*AC7.1*					Reproduction	Frooninckx et al, 2012
	npr-22a	*Y59H11AL.1*		**FLP-1-6, FLP-7-1, FLP-7-2, FLP-7-3, FLP-7-4, FLP-9 , FLP-11-1, FLP-11-2, FLP-11-3, FLP-13-4, FLP-22**				Rogers et al., 2001; Mertens et al., 2006; Bendena et al., 2012
	npr-22b	*Y59H11AL.1*						
	npr-21	*T23C6.5*						
		C49A9.7						
		C50F7.1a&b			AIY			Wenick and Hobert, 2004
	npr-33	*F31B9.1*						
Gastrin/Cholecystokinin (CCK)-like receptors group						Class A Rhodopsin family-Group IIIB		Keating et al., 2003
	ckr-1	*T23B3.4*				Encodes a seven transmembrane receptor that is most closely related to the mammalian cholecystokinin receptors	Loss of T23B3.4 activity via RNAi, either singly or in combination with another cholecystokinin receptor-encoding gene, Y39A3B.5, has no effect on fat metabolism, however large-scale RNAi screens have reported that T23B3.4(RNAi) results in embryonic lethality and reduced brood sizes	Rual et al, 2004
	ckr-2a	*Y39A3B.5*		**FLP-1, NLP-12A, NLP-12B, NLP-13, NLP-14**	AIY		Locomotion, fat storage, amylase activity/secretion	Wenick & Hobert, 2004; McKay et al., 2007; Janssen et al., 2008b; Hu et al, 2011; Bendena et al., 2012
	ckr-2b	*Y39A3B.5*						
	npr-20	*T07D4.1*						
Homolog/ Ortholog	**C. elegans gene**	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other notes**	**References**

Gonadotropin releasing hormone, oxytocin, vasopressin-like receptors group						Class A Rhodopsin family-Group V		Keating et al., 2003
human GnRHR	*gnrr-1a*	*F54D7.3*	(human GoNadotropin-Releasing hormone Receptor (GnRHR) related)	**NLP-47**			Reproduction	Lindemans et al, 2009
	gnrr-1b	*F54D7.3*						
	gnrr-2a&b	*C15H11.2*						
	gnrr-3	*ZC374.1*						
	gnrr-4a-c	*C41G11.4*						
	gnrr-5	*H22D07.1*						
	gnrr-6	*F13D2.2*						
	gnrr-7	*F13D2.3*						
	gnrr-8	*Y105C5A.23*						
Human Vasopressin receptor type 2 (AVPR2)	*ntr-1*	*T07D10.2*		**NTC-1 (aka ne**			Gustatory associative learning; the vasopressin/oxytocin-related neuropeptide, NTC-1, facilitates the experience-driven modulation of salt chemotaxis through activation of NTR-1. Male-mating behavior; Males lacking NTC-1 or NPR-1 or NPR-2 perform poorly in reproductive behaviors, including mate search, mate recognition, and mating, but other sensorimotor behaviors are intact. In mutants, mating motor patterns are fragmented and inefficient, suggesting that oxytocin/vasopressin peptides increase the coherence of mating behaviors. NTR-1 and NTR-2 can contribute to nematocin-mediatedsignaling alone (NTR-1) or as heterodimers (NTR-1/NTR-2).	Beets et al, 2012; Garrison et al, 2012
	ntr-2	*F14F4.1*					Male-mating behavior; Males lacking NTC-1 or NPR-1 or NPR-2 perform poorly in reproductive behaviors, including mate search, mate recognition, and mating, but other sensorimotor behaviors are intact. In mutants, mating motor patterns are fragmented and inefficient, suggesting that oxytocin/vasopressinpeptides increase the coherence of mating behaviors.NTR-1 and NTR-2 can contribute to nematocin-mediatedsignaling alone (NTR-1) or as heterodimers (NTR-1/NTR-2).	Garrison et al, 2012
Neurotensin, neuromedin U, growth hormone secretagogue, thyrotropin releasing hormone (TRH)-like receptors group						Class A Rhodopsin family-Group IIIB		Keating et al 2003
	nmur-1	*C48C5.1*						
Vertebrate NMU (neuromedin U) receptor	*nmur-2*	*K10B4.4*		**NLP-44**		Encodes a G protein-coupled receptor that is similar to the insect PK-1 (pyrokinin-1) receptor and the vertebrate NMU (neuromedin U) receptor	When expressed in HEK293T cells, the product of K10B4.4 is able to bind a synthetic AFFYTPRI-NH2 neuropeptide whose sequence is derived from the protein product of Y23B4A.2 (Y23B4A.2 encodes a neuropeptide precursor that can produce a pyrokinin (PK)-like peptide and two periviscerokinin (PVK)-like peptides)	Lindemans et al., 2009
	nmur-3a&b	*F02E8.2*						
	nmur-4	*C30F12.6*						
	frpr-10	*F57H12.4*						
	dmsr-1a&b	*F57B7.1*						Hewes and Taghert, 2001
	egl-6a&b	*C46F4.1*		**FLP-10, FLP-17-1, FLP-17-2**	HSN, head glia		EGL-6 functions as a receptor for FMRFamide-related peptides that inhibit activity of the HSN motor neurons	Hewes and Taghert, 2001, Ringstad and Horvitz, 2008
		D1014.2						Hewes and Taghert, 2001
		B0563.6						Hewes and Taghert, 2001
	sprr-1	R03A10.6	GPCR. 7TM serpentine receptor class w (Srw). D. melanogaster sex peptide receptor-related.					
	sprr-2	F42D1.3	GPCR.7TM rhodopsin family. GPCR for small molecule neurotransmitters. Serpentine receptor class w (srw). D. melanogaster sex peptide receptor-related.					Keating et al, 2003
	sprr-3	Y69A2AR.15	GPCR. 7TM serpentine receptor class w (srw). D. melanogaster sex peptide receptor-related.					
	frpr-7	F39B3.2						
		K03H6.5						
	aexr-3	C48C5.3						
		T10E10.3						
		T21H3.5						
		Y70D2A.1						
		ZK1307.7						
		B0034.5						
		B0334.6						
MECA receptors group								
	npr-19	C02H7.2	Cannabinoid receptor-like					Mills et al., 2012
Homolog/ Ortholog	**C. elegans gene**	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other Notes**	**References**
Class B/Secretin Family of GPCRs								
	lat-1a&b	*B0457.1*	Class B subfamily B2 (LNB-TM7 proteins)		AIY			Harmar 2001; Wenick and Hobert, 2004
	lat-2	*B0286.2*	aka tag-12. Class B subfamily B2 (LNB-TM7 proteins)		g1 gland cells and in the arcade cells in the head, and its expression has been reported to cycle with larval molts	Encodes a predicted transmembrane protein that is homologous to vertebrate latrophilins, alpha-latrotoxin binding proteins that are members of the Class B/secretin family of G protein-coupled receptors	Loss of lat-2 activity via large-scale RNAi screens does not result in any obvious abnormalities, the precise role of LAT-2 in C. elegans development and/or behavior is not yet known	Kamath et al., 2003; Harmar 2001
	seb-2	*ZK643.3*	aka secr-1. Class B subfamily B1 (hormone receptors)		Head muscles, the vm1 vulval muscles, and an unidentified cell(s) in the anal region	Encodes a transmembrane protein with similarity to the secretin family of G-protein-coupled receptors; unlike other members of this family, however, the product of ZK643.3 contains six, rather than seven, predicted transmembrane domains		Lynch et al, 1995; Harmar 2001; Cardoso et al., 2006
Vasoactive intestinal protein; Adenylate cyclase-coupled calcitonin receptor	*seb-3*	*C18B12.2*	aka secr-2. Class B subfamily B1 (hormone receptors)			Encodes a corticotropin-releasing factor (CRF) receptor-like G-protein-coupled receptor (GPCR)	Mediates the expression of a distinct locomotory state, regulates behavioral responses to environmental stress and ethanol.	Harmar 2001; Cardoso et al., 2006; Jee et al, 2012
Drosophila pigment dispersing factor (PDF) receptors and human CALCR	*pdfr-1a-c*	*C13B9.4*	Class B subfamily B1 (hormone receptors). Orthologous to Drosophila pigment dispersing factor (PDF) receptors and to human CALCR	**PDFR-1a: PDF-1a, PDF-1b, PDF-2 (aka NLP-37)**	All body wall muscles, two vulval cells, PHA, PHB, PLM, ALM, FLP, OLQD, OLQV, RMED, I1 pharyngeal interneuron pair, and a single sensory neuron R3 in the male tail. Internal and external environment-sensing neurons URY, PQR and PHA.	Encodes, by alternative splicing, three isoforms of a G-protein-coupled receptor (C13B9.4a,b,c) required for normal locomotion	Excess PDF-2 induces a movement phenotype like that seen in a pdf-1 null mutant, indicating that PDF-1a/b and PDF-2 exert opposite effects on PDFR-1. Plays role in locomotion and reproduction. Locomotion quiescence during lethargus and arousal from lethargus are mediated by decreased and increased levels of PDF-1 neuropeptide secretion, respectively. PDFR-1 signaling sensitizes response of microtubule cells to touch, facilitating arousal. PDF-1 in AIM and PDFR-1 in URY, PQR and PHA are required for mate-searching behavior of males.	Harmar 2001; Cardoso et al., 2006; Janssen et al., 2008; Janssen et al., 2010; Meelkop et al., 2012; Barrios et al., 2012; Choi et al 2013
		F31D5.4?						
		F31D5.5?						
Homolog/ Ortholog	**C. elegans gene**	**Sequence name**	**Type**	**Ligand**	**Expression pattern**	**Properties**	**Other Notes**	**References**
Insulin/IGF receptor-like proteins								Dlakic, 2002

ins/IGF receptor	*daf-2*	*Y55D5A.5*	Receptor tyrosine kinase	**DAF-28, INS-1, INS-7**	Head neurons, XXXL/R, intestine, gonad	Encodes a receptor tyrosine kinase that is the C. elegans insulin/IGF receptor ortholog	DAF-2 activity is required for a number of processes in C. elegans, including embryonic and larval development, formation of the developmentally arrested dauer larval stage (diapause), larval developmental timing, adult longevity, reproduction, fat storage, salt chemotaxis learning, and stress resistance, including response to high temperature, oxidative stress, and bacterial infection; DAF-2 signals through a conserved PI 3-kinase pathway to negatively regulate the activity of DAF-16, a Forkhead-related transcription factor, by inducing its phosphorylation and nuclear exclusion; in addition, DAF-2 negatively regulates the nuclear localization, and hence transcriptional activity, of SKN-1 in intestinal nuclei;	Kimura et al., 1997; Tatar et al., 2003; Tomioka et al., 2006; Kimura et al., 2011
		C04G2.11	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		C30G4.6	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		C31E10.3	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		C41G6.6	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F02C12.4	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F11A5.7	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F14D2.17	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F14D2.6	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F15E11.11	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F15E11.2	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F15E11.3	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F15E11.4	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F15E11.5	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F38A5.11	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F45C12.1	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F45C12.16	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F54G8.1	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F56A4.9	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F58E1.4	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F58E1.7	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F59D6.4	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		F59D6.6	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
	hpa-1	*H25K10.5*			Neurons and the phasmid socket cells in larvae and young adults; posterior intestine, the amphid and phasmid socket cells, a few neurons in adults	Encodes one of 54 C. elegans insulin receptor-related proteins, predicted secreted proteins that contain regions of similarity to the extracellular ligand-binding domains of the insulin and epidermal growth factor (EGF) receptors	Functions in older adult animals to negatively regulate aging-associated changes, such as locomotory capacity, pigment accumulation, and pharyngeal pumping; in regulating these aspects of healthspan. Appears to function as a negative regulator of the PLC-3/ITR-1 branch of the LET-23/EGFR-mediated signaling pathway	Iwasa et al., 2010
		H25K10.6	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		K04F1.10	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		K04F1.11	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		K04F1.12	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		K04F1.13	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		K04F1.14	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		K04F1.6	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					

		K04F1.7	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		K12D9.12	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		K12D9.14	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		R03G5.3	Contains EGF receptor L domain as well as hidden Markov model-predicted transmembrane helices					
		T01C3.5	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		T05A6.4	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		T05A6.5	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		T11F1.2	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		T11F1.6	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
	hpa-2	T11F1.8			Neurons and the phasmid socket cells in larvae and young adults; posterior intestine, the amphid and phasmid socket cells, a few neurons in adults	Encodes one of 54 C. elegans insulin receptor-related proteins, predicted secreted proteins that contain regions of similarity to the extracellular ligand-binding domains of the insulin and epidermal growth factor (EGF) receptors	Functions in older adult animals to negatively regulate aging-associated changes, such as locomotory capacity and pharyngeal pumping; in regulating these aspects of healthspan. Appears to function as a negative regulator of the PLC-3/ITR-1 branch of the LET-23/EGFR-mediated signaling pathway	Iwasa et al., 2010
		T11F1.9	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		T26E4.1	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		Y19D10A.7	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		Y19D10B.2	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		Y19D10B.3						
		Y19D10B.5	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		Y37A1B.8	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		Y37A1B.9	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		Y38C9B.3	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		Y46H3D.4	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		Y70C5C.3	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		Y73F8A.18	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		ZC482.2	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		ZC482.3	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		ZC482.4	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		ZC482.7	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		ZK1037.1	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		ZK355.5	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		ZK355.6	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					
		ZK355.7	Extracellular protein without tyrosine kinase domain, contains EGF receptor L domain					

*Currently, most expression patterns are partial and should not be considered as final. **Wormbase and Hunt Newbury et al., 2007 were used as general references.

By Zeynep F. Altun, to whom correspondence should be addressed. E-mail: zeynep.altun@einstein.yu.edu. This page should be cited as: Altun, Z.F. 2011. Neurotransmitter Receptors in C. elegans. In WormAtlas. doi: 10.3908/wormatlas.5.202. Last revision: February 14, 2013.