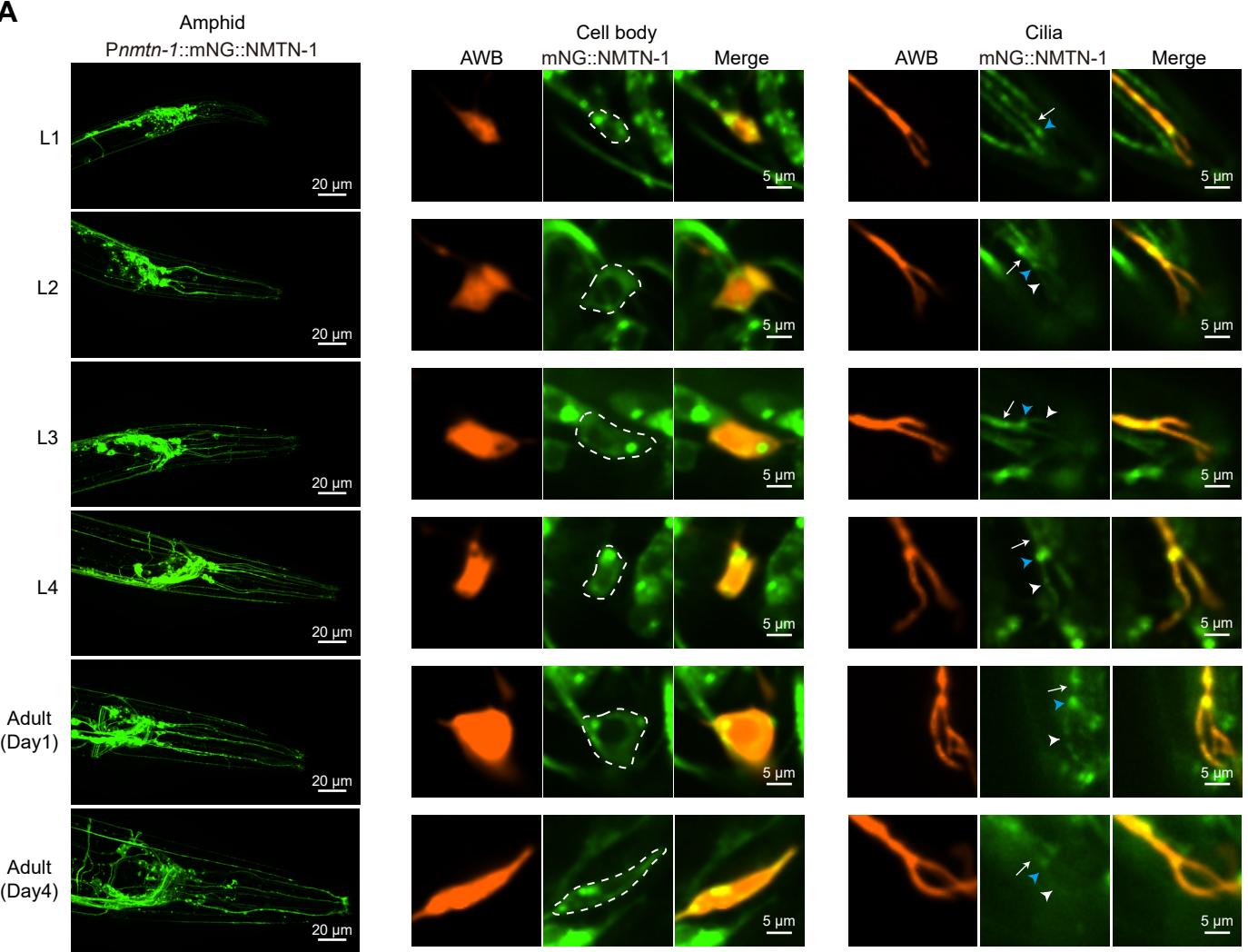
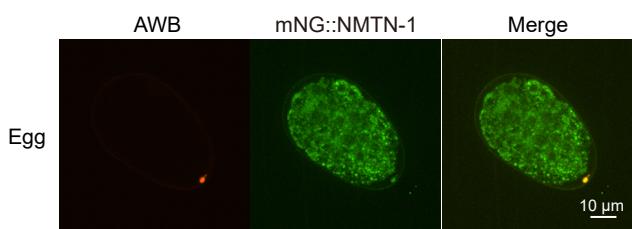


A



B



C

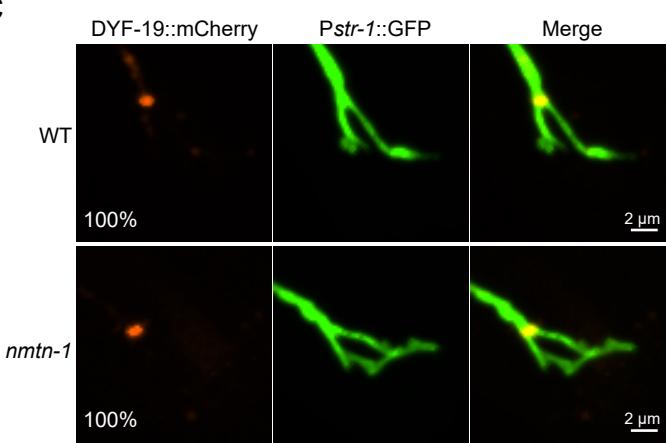


Fig. S1. The expression pattern of *Pnmtn-1::mNG::NMTN-1* at different *C. elegans* developmental stages. (A) Representative images showing *Pnmtn-1::mNG::NMTN-1* signals in the L1, L2, L3, L4, day 1 adult, and day 4 adult of *C. elegans*. The AWB neurons were visualized by expression of *Pstr-1::mCherry*. The dotted lines represent the AWB neurons. White arrowhead, blue arrowhead, and white arrow indicate cilia, the cilia base, and dendrites, respectively. (B) Representative images showing *Pnmtn-1::mNG::NMTN-1* signals in the egg of *C. elegans*. The AWB neurons are marked by expression of *Pstr-1::mCherry*. (C) Representative images of *Pstr-1::DYF-19::mCherry* localization in the AWB neurons of wild type (WT) and *nmtn-1* mutants.

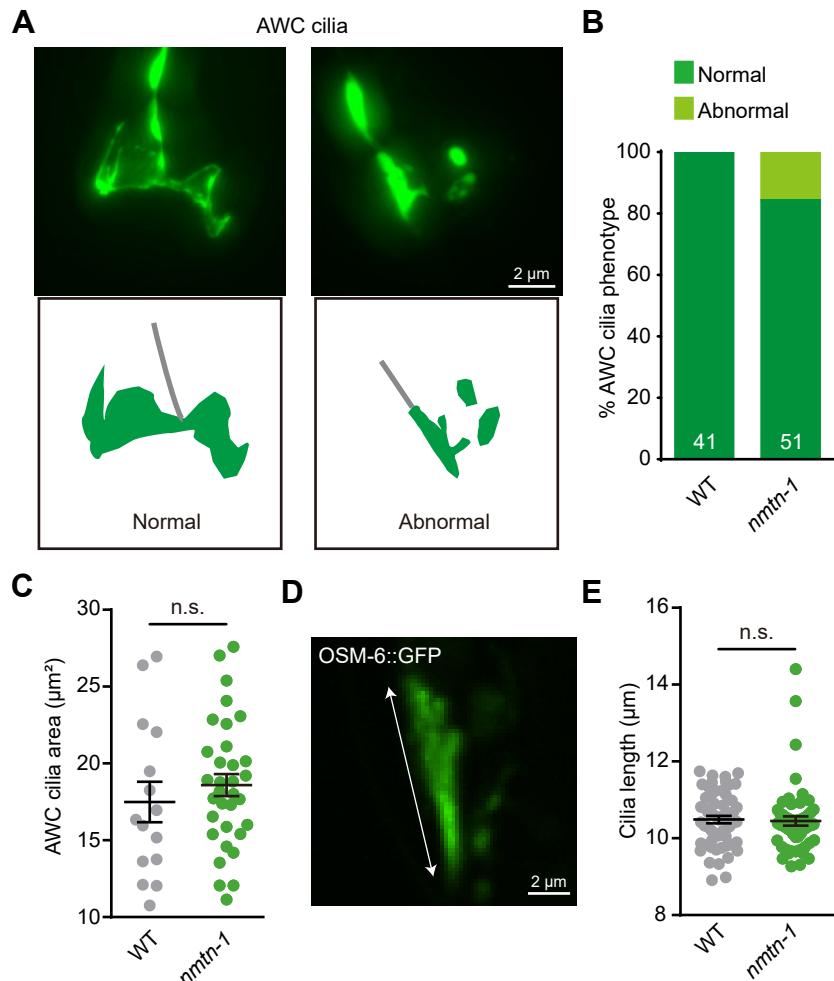
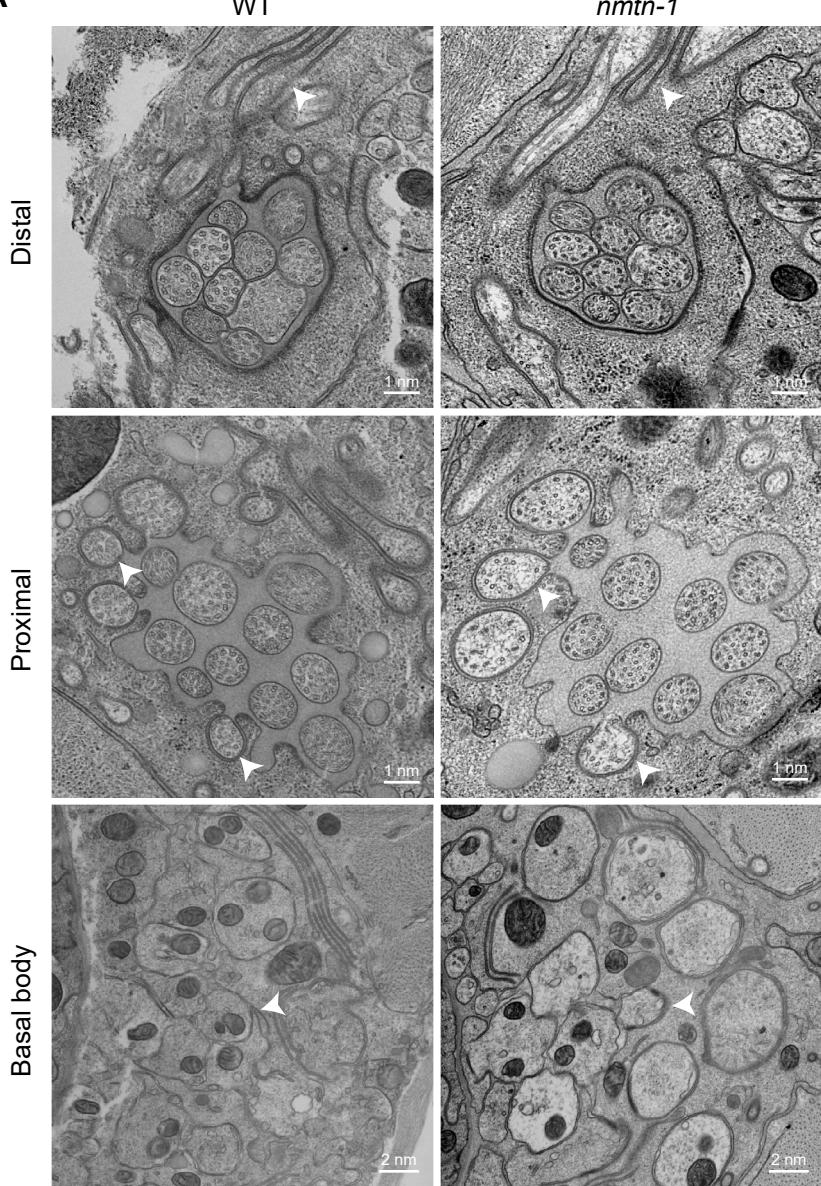
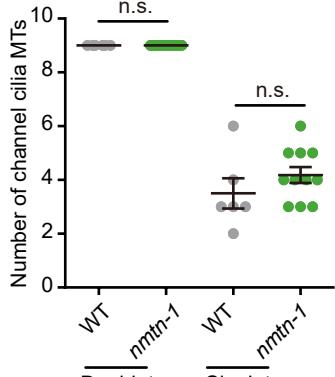


Fig. S2. *nmtn-1* mutants do not have defects in the morphology of other olfactory neurons. (A) Representative images (top) and cartoons (bottom) of the normal and abnormal cilia of the AWC neurons. The AWC cilia were visualized by expression of *Pstr-2::GFP*. (B) The percentages of animals having the normal and abnormal cilia of the AWC neurons in wild type (WT) and *nmtn-1* mutants are shown. (C) Quantification of the AWC cilia area in WT and *nmtn-1* mutants. Each cilium analyzed is represented by a dot. n = 15 for WT and n = 33 for *nmtn-1* mutants. Data are presented as mean values \pm SEM. (D) Representative image of the OSM-6::GFP fusion protein. The line represents the length of cilia labeled by OSM-6::GFP. (E) Quantification of the cilia length labeled by OSM-6::GFP in WT and *nmtn-1* mutants. Each cilium analyzed is represented by a dot. n = 57 for WT and n = 55 for *nmtn-1* mutants. Data are presented as mean values \pm SEM. In C and E, n.s. not significant by unpaired two-tailed Student's t-test.

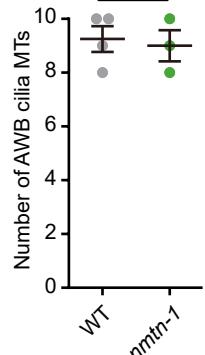
A



B



C



D

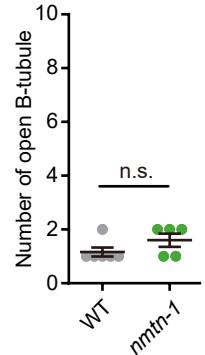


Fig. S3. Ultrastructure of amphid cilia in wild type (WT) and *nmtn-1* mutants.

(A) Representative SEM images (cross-sections) of the amphid cilia at distal, proximal, and basal body in WT and *nmtn-1* mutants. White arrowheads indicate the AWB cilia. (B) Quantification of the channel cilia doublet and singlet microtubules (MTs) in WT and *nmtn-1* mutants. Each cilium analyzed is represented by a dot. n = 6 for WT and n = 11 for *nmtn-1* mutants. Data are presented as mean values ± SEM. (C) Quantification of AWB cilia MTs in WT and *nmtn-1* mutants. Each cilium analyzed is represented by a dot. n = 4 for WT and n = 3 for *nmtn-1* mutants. Data are presented as mean values ± SEM. (D) Quantification of axonemes having open-B tubules in WT and *nmtn-1* mutants. Each axonemes analyzed is represented by a dot. n = 6 for WT and n = 5 for *nmtn-1* mutants. Data are presented as mean values ± SEM. In B, C and D, n.s. not significant by unpaired two-tailed Student's t-test.

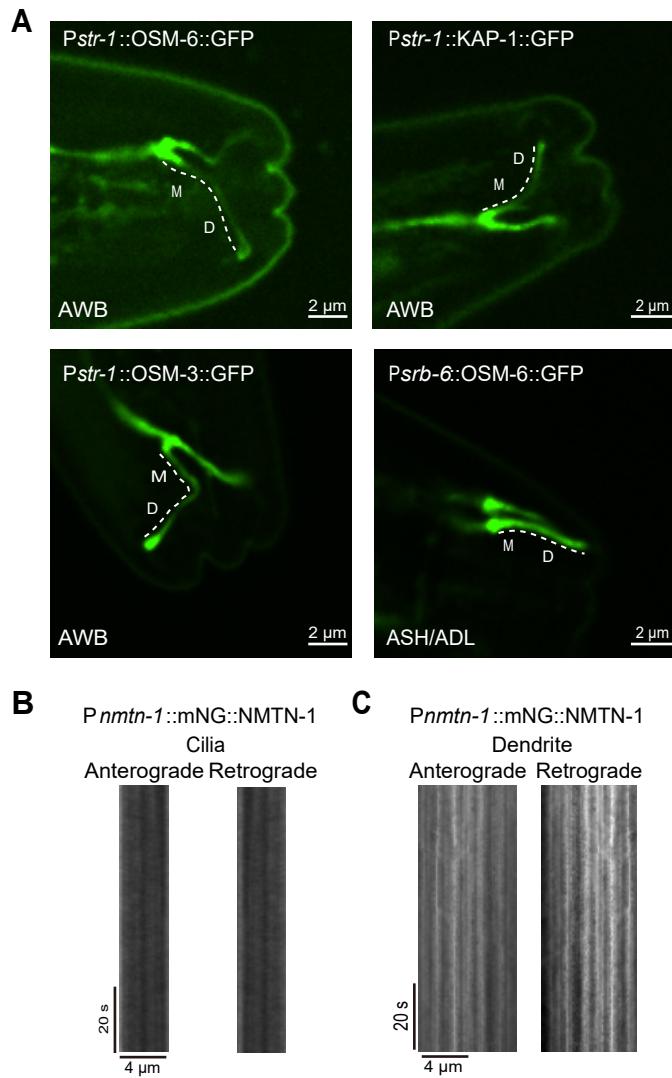


Fig. S4. Representative images of IFT movement in the cilia and dendrites. (A) Representative images of *Pstr-1::OSM-6::GFP*, *Pstr-1::OSM-3::GFP*, *Pstr-1::KAP-1::GFP*, and *Psrb-6::OSM-6::GFP* for analyses of IFT particle movement. (B) The kymograph image of NMTN-1 in cilia. The anterograde and retrograde kymograph images of *Pnmtn-1::mNG::NMTN-1* fusion protein show that NMTN-1 is not moving by itself in cilia. (C) The kymograph image of NMTN-1 in the dendrites. The anterograde and retrograde kymograph images of *Pnmtn-1::mNG::NMTN-1* fusion protein show that NMTN-1 is not moving by itself in the dendrites.

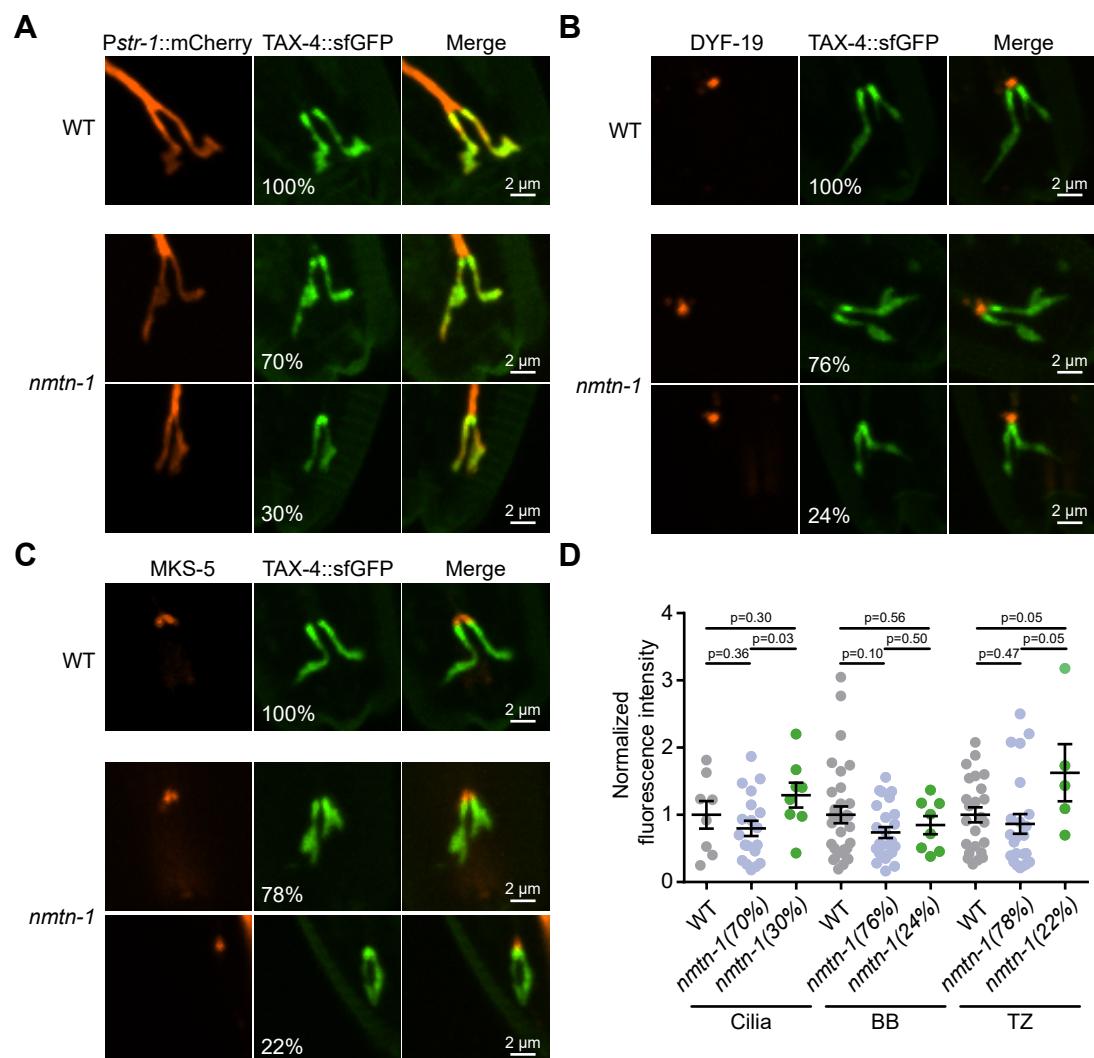


Fig. S5. Localization of ciliary channel may be altered in *nmtn-1* mutants. (A) Representative images of the *Pstr-1::TAX-4::sfGFP* fusion protein and the AWB cilia marked by *Pstr-1::mCherry* in WT and *nmtn-1* mutants. TAX-4 is localized throughout cilia in all of WT animals, while TAX-4 is clearly detained the base of cilia in 30% of *nmtn-1* mutants. (B) Representative images of the *Pstr-1::TAX-4::sfGFP* fusion protein and the BB protein marked by *Pstr-1::DYF-19::mCherry* in WT and *nmtn-1* mutants. TAX-4 is localized throughout cilia in all of WT animals, while TAX-4 is clearly detained the base of cilia in 24% of *nmtn-1* mutants. (C) Representative images of the *Pstr-1::TAX-4::sfGFP* fusion protein and the TZ protein marked by *Pstr-1::MKS-5::mCherry* in WT and *nmtn-1* mutants. TAX-4 is localized throughout cilia in all of WT animals, while TAX-4 is clearly detained the base of cilia in 22% of *nmtn-1* mutants. (D) Quantification of the fluorescence intensities of *Pstr-1::TAX-4::sfGFP* in cilia, BB and TZ of WT and *nmtn-1* mutants. Each cilium analyzed is represented by a dot. n = 8 for WT, n = 19 for 70% *nmtn-1* mutants with normal morphology, n = 8 for 30% *nmtn-1* mutants with abnormal morphology in A. n = 32 for WT, n = 25 for 76% *nmtn-1* mutants with normal morphology, n = 8 for 24% *nmtn-1* mutants with abnormal morphology in B. n = 24 for WT, n = 23 for 78% *nmtn-1* mutants with normal morphology, n = 5 for 22% *nmtn-1* mutants with abnormal morphology in C. Data are presented as mean values ± SEM. p values were calculated by unpaired two-tailed Student's t-test.

Table S1. List of reagents used in this study

Summary of strain name, genotype, generating method, and resource of *C. elegans* strains. Chemicals, kits, and primers used for generating cell-specific promoters were also listed.

<i>C. elegans</i> strains used in this study			
Strain name	Genotype	Method	Resource
N2	Wild type	-	CGC
TM5438	<i>nmtn-1(tm5438) I</i>	-	NBRP
TXJ0539	<i>xjls0003[Pstr-1::GFP+Pmyo-3::mCherry]</i>	Microinjection	In this study
TXJ0553	<i>nmtn-1(tm5438) I; xjls0003[Pstr-1::GFP+Pmyo-3::mCherry]</i>	Genetic cross	In this study
SYD0202	<i>[OSM-6::GFP]</i>	-	Guangshuo Ou
TXJ0649	<i>nmtn-1(tm5438) I; [OSM-6::GFP]</i>	Genetic cross	In this study
TXJ0230	<i>xjEX0007[Pstr-1::nmtn-1+Pmyo-3::mCherry]</i>	Microinjection	In this study
TXJ0237	<i>xjEX0008[Pstr-1::nmtn-1+Pmyo-3::mCherry]</i>	Microinjection	In this study
TXJ0228	<i>xjEX0009[Pstr-1::nmtn-1+Pmyo-3::mCherry]</i>	Microinjection	In this study
TXJ0235	<i>xjEX0010[Pnmtn-1::nmtn-1+Pmyo-3::mCherry]</i>	Microinjection	In this study
TXJ1649	<i>xjEX0118[Pnmtn-1::nmtn-1+Pmyo-3::mCherry]</i>	Microinjection	In this study
TXJ0486	<i>xjEx0019[Pnmtn-1::mNG::NMTN-1+Pstr-1::mCherry +Plin-44::GFP]</i>	Microinjection	In this study
TXJ1000	<i>xjEx0073[Pnmtn-1::NMTN-1::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ0571	<i>xjEx0031[Pstr-2::GFP+Pmyo-3::mCherry]</i>	Microinjection	In this study
TXJ0570	<i>nmtn-1(tm5438) I; xjEx0031[Pstr-2::GFP+Pmyo-3::mCherry]</i>	Genetic cross	In this study
TXJ0912	<i>xjEx0072[Pstr-1::OSM-6::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1187	<i>nmtn-1(tm5438) I;</i> <i>xjEx0072[Pstr-1::OSM-6::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Genetic cross	In this study
TXJ1614	<i>nmtn-1(tm5438) I; kap-1(ok676) II.</i> <i>xjEx0072[Pstr-1::OSM-6::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Genetic cross	In this study

TXJ1615	<i>nmtn-1(tm5438) I; klp-11(tm324)IV. xjEx0072[Pstr-1::OSM-6::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Genetic cross	In this study
TXJ1665	<i>nmtn-1(tm5438) I; osm-3(p802) IV. xjEx0072[Pstr-1::OSM-6::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Genetic cross	In this study
TXJ1597	<i>nmtn-1(tm5438) I; bbs-8(nx77)V. xjEx0072[Pstr-1::OSM-6::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Genetic cross	In this study
TXJ1015	<i>xjEx0074[Pstr-1::TAX-4::sfGFP+ Pstr-1::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1206	<i>nmtn-1(tm5438) I; xjEx0074[Pstr-1::TAX-4::sfGFP+ Pstr-1::mCherry+ Plin-44::GFP]</i>	Genetic cross	In this study
TXJ1028	<i>xjEx0075[Pnmtn-1::GFP+Pstr-1::mCherry +Plin-44::GFP]</i>	Microinjection	In this study
TXJ1031	<i>xjEx0076[Pnmtn-1::GFP+Pstr-2::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1030	<i>xjEx0077[Pnmtn-1::GFP+Podr-10::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1029	<i>xjEx0078[Pnmtn-1::GFP+Psrb-6::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1229	<i>xjEx0096[Pstr-1::DYF-19::mCherry +Pstr-1::mNG::nmtn-1 +Plin-44::GFP]</i>	Microinjection	In this study
TXJ1669	<i>xjEx0105[Pstr-1::MKS-5::mCherry +Pstr-1::mNG::nmtn-1 +Plin-44::GFP]</i>	Microinjection	In this study
TXJ1311	<i>xjEx0097[Pstr-1::DYF-19::mCherry+ Pstr-1::GFP+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1260	<i>nmtn-1(tm5438) I; xjEx0097[Pstr-1::DYF-19::mCherry+ Pstr-1::GFP+Plin-44::GFP]</i>	Genetic cross	In this study
TXJ1271	<i>xjEx0082[Pnmtn-1::GFP+Pmyo-3::mCherry]</i>	Microinjection	In this study
TXJ1366	<i>xjEx0098[Pstr-1::KAP-1::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1380	<i>nmtn-1(tm5438) I; xjEx0098[Pstr-1::KAP-1::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Genetic cross	In this study
TXJ1399	<i>xjEx0099[Pstr-1::OSM-3::mNG+Pstr-1::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1432	<i>nmtn-1(tm5438) I; xjEx0099[Pstr-1::OSM-3::mNG+Pstr-</i>	Genetic cross	In this study

	1::mCherry+Plin-44::GFP]		
TXJ1428	<i>xjEx0100[PsrB-6::OSM-6::mNG+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1431	<i>nmtN-1(tm5438) I; xjEx0100[PsrB-6::OSM-6::mNG+Plin-44::GFP]</i>	Genetic cross	In this study
TXJ1429	<i>xjEx0101[Pstr-1::TAX-4::sfGFP+ Pstr-1::DYF-19::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1430	<i>nmtN-1(tm5438) I; xjEx0101[Pstr-1::TAX-4::sfGFP+ Pstr-1::DYF-19::mCherry + Plin-44::GFP]</i>	Microinjection	In this study
TXJ1660	<i>xjEx0103[Pstr-1::TAX-4::sfGFP+ Pstr-1::MKS-5::mCherry+Plin-44::GFP]</i>	Microinjection	In this study
TXJ1661	<i>nmtN-1(tm5438) I; xjEx0103[Pstr-1::TAX-4::sfGFP+ Pstr-1::MKS-5::mCherry + Plin-44::GFP]</i>	Genetic cross	In this study
TXJ1042	<i>nmtN-1(tm5438) I; xjEx0106[Pstr-1::mNG::NMTN-1 + Plin-44::GFP]</i>	Microinjection	In this study

Key resources table		
Chemicals and kits		
Reagent or Resource	Source	Identifier
2,3-Butanedione monoxime	Sigma	Cat#: B0753
Levamisol hydrochloride	Sigma	Cat#: 31742
Dil	Molecular Probes	Cat#: D-282
2-Nonanone	Aladdin	Cat#: N105585
Diacetyl	Sinopharm	Cat#: 80042427
Octanol	Sangon Biotech	Cat#: A504032-0250
Isopentyl alcohol	Sangon Biotech	Cat#: A610278-0500
QIAprep Spin Miniprep Kit	Qiagen	Cat#: 27106
TIANPrep Rapid Mini Plasmid kit	TIANGEN	Cat#: DP105-03
PrimeSTAR Max DNA Polymerase	Takara	Cat#: R045A
Hieff CLoneTM Plus One Step Cloing Kit	Yeasen	Cat#: 10911ES62
TIANquick Midi Purification Kit	TIANGEN	Cat#: DP204-03

Primers information	
Pstr-1 F	aagcttgagtgagaagaatgtcacg
Pstr-1 R	gtcgacttagtcaaatgatatgaagtt
Pstr-2 F	aagcttatataaaatcaatggatc
Pstr-2 R	gtcgactttatggatcacgagtttc
Podr-10 F	aagctttaattttcataattgactc
Podr-10 R	gtcgacggagctgtaaaggatcttaatg
Psrb-6 F	tctactttaaatattatatcttctaattttgcacgaa
Psrb-6 R	ttttatcttctgttagaaattcaagactgatca
Pnmtm-1 F	gaaccattgacataatgcttc
Pnmtm-1 R	tttagcatggataatgttattgcg