A cytoplasmic Argonaute protein promotes the inheritance of RNAi

Fei Xu[1ǂ], Xuezhu Feng[1ǂ], Xiangyang Chen[1], Chenchun Weng[1], Qi Yan[1], Ting Xu[1], Minjie Hong[1], and Shouhong Guang[1,2,3]*

[1]Hefei National Laboratory for Physical Sciences at Microscale, School of Life Sciences, University of Science and Technology of China, Hefei, Anhui 230027, P.R. China

[2]CAS Center for Excellence in Molecular Cell Science, Chinese Academy of Sciences, P.R. China

[3]Lead Contact

ǂThese authors contributed equally to this work.

*To whom correspondence should be addressed. Tel.: +86 551 6360 7812, Fax: +86 551 6360 1443, E-mail: sguang@ustc.edu.cn

Running title: WAGO-4 mediates inheritance of RNAi

Keywords: Nrde, WAGO-4, inheritance, Argonaute, RNAi

Summary:

RNAi-elicited gene silencing is heritable and can persist for multiple generations after its initial induction in *C. elegans*. However, the mechanism by which parental-acquired trait-specific information from RNAi is inherited by the progenies is not fully understood. Here, we identified a cytoplasmic Argonaute protein, WAGO-4, necessary for the inheritance of RNAi. WAGO-4 exhibits asymmetrical translocation to the germline during early embryogenesis, accumulates at the perinuclear foci in the germline, and is required for the inheritance of exogenous RNAi targeting both germline- and soma-expressed genes. WAGO-4 binds to 22G-RNAs and their mRNA targets. Interestingly, WAGO-4-associated endogenous 22G-RNAs target the same cohort of germline genes as CSR-1 and contain untemplated addition of uracil at the 3' ends. The poly(U) polymerase CDE-1 is required for the untemplated uridylation of 22G-RNAs and inheritance of RNAi. Therefore, we conclude that, in addition to the nuclear RNAi pathway, the cytoplasmic RNAi machinery also promotes RNAi inheritance.

Introduction:

RNAi-elicited gene silencing is heritable and can perpetuate for a number of generations in *C. elegans* (reviewed in (Heard and Martienssen, 2014; Miska and Ferguson-Smith, 2016; Rechavi and Lev, 2017). Both exogenously derived siRNAs (exo-siRNAs) and endogenous small RNAs, such as endo-siRNAs and PIWI-interacting small RNAs (piRNAs), can trigger heritable RNAi. Transgenerational inheritance of RNAi allows organisms to remember their exposure to genome parasites, such as viruses and transposons, transmit the experience to descendants, and promote evolutional advantages to enable selection for physiologically important traits. Although many lines of evidence have demonstrated that the RNAi machinery and small RNAs are involved in the initial establishment and ultimate maintenance of silencing, the precise nature of the trait-specific information that is transmitted from the parents to their progeny remains largely unclear (Ashe et al., 2012; Buckley et al., 2012; Burton et al., 2017; Kalinava et al., 2017; Klosin et al., 2017; Lev et al., 2017; Luteijn et al., 2012; Marre et al., 2016; Shirayama et al., 2012; Spracklin et al., 2017; Weiser et al., 2017).

The mechanisms of transgenerational inheritance of RNAi are widely being investigated in *C. elegans*. The RNAi-mediated silencing effect can be transmitted *via* parental gametes (Alcazar et al., 2008; Grishok et al., 2000) and its maintenance depends on the expression of the targeted genes in germline and post-transcriptional mechanisms (Minkina and Hunter, 2017). Chromatin-modifying enzymes and their associated factors, including HPL-2, SET-25, SET-32, MES-2, and HDA-4 are engaged in the re-establishment and maintenance of transgenerational gene silencing (Ashe et al., 2012; Luteijn et al., 2012; Mao et al., 2015; Shirayama et al., 2012; Vastenhouw et al., 2006). The RNAi spreading defective factors RSD-2 and RSD-6 also promote genome silencing by maintaining siRNA populations (Sakaguchi et al., 2014). Especially, the nuclear RNAi defective (Nrde) pathway plays essential roles in the inheritance of RNAi silencing (Ashe et al., 2012; Buckley et al., 2012; Burton et al., 2011; Gu et al., 2012; Mao et al., 2015; Marre et al., 2016; Shirayama et al., 2012;

Weiser et al., 2017). The germline-expressed nuclear Argonaute protein HRDE-1 may carry heritable small RNAs and engage in RNAi inheritance (Buckley et al., 2012). It was shown that the nuclear RNAi pathway maintains siRNA expression in the progeny of dsRNA-treated animals (Burton et al., 2011).

Although the precise nature of the trait-specific information that is directly inherited remains unknown, both small RNAs and dsRNAs have been reported to transmit from the parents to progeny in *C. elegans* (Rechavi and Lev, 2017). In addition, it is unclear whether and to what extent the cytoplasmic RNAi machinery contributes to the inheritance of RNAi (Spracklin et al., 2017). The cytoplasmic Argonaute protein WAGO-1 has been implicated in the maintenance of silencing (Shirayama et al., 2012). Yet another study showed that WAGO-1 is not required for RNAi inheritance of a *pie-1*$_p$*::gfp::h2b* transgene (Buckley et al., 2012).

To further understand the mechanisms of RNAi inheritance, we searched for factors required for silencing a germline-expressed *h2b::gfp* transgene in the progenies of animals exposed to exogenous dsRNA. We identified the cytoplasmic Argonaute protein WAGO-4. WAGO-4 is specifically required for the exogenous dsRNA-induced silencing of germline-expressed genes. WAGO-4 binds to germline-enriched 22G-RNAs containing untemplated addition of uracil at 3' ends, which depends on the poly(U) polymerase CDE-1. After fertilization, in the zygotes and early embryos, WAGO-4 exhibits asymmetrical translocation to the germline. Therefore, we conclude that cytoplasmic RNAi machineries also contribute to the inheritance of RNAi, likely through the Argonaute protein WAGO-4.

Results:

WAGO-4 is required for inheritance of RNAi.

DsRNA targeting *lin-15b* elicits a multivulva (Muv) phenotype in enhanced RNAi (*eri*) animals through the nuclear RNAi defective (Nrde) pathway (Guang et al., 2008). However, the animals exhibit the Muv phenotype only in the F1 progeny but

not in the parent animals, suggesting that the progenies have inherited a silencing signal. We have previously tested a number of chromatin modification factors and Argonaute proteins by examining *lin-15*-RNAi induced Muv phenotype and *lir-1*-RNAi-induced larval arrest. However, we failed to identify any except for *nrde* genes and *mes-2* that were required for both RNAi-induced phenotypes (Mao et al., 2015). Interestingly, we found that an Argonaute gene, *wago-4,* was required for *lin-15*-RNAi-induced Muv phenotype in the F1 progeny but not for *lir-1*-RNAi-induced larval arrest in the parental generation, suggesting that WAGO-4 may act through the germline to mediate RNAi inheritance.

WAGO-4 belongs to the worm-specific clade Argonaute proteins (Yigit et al., 2006). We acquired two deletion alleles *tm1019* and *tm2401,* from the National BioResource Project (NBRP) (Figure S1A). In addition, we used dual sgRNA-mediated CRISPR/Cas9 technology to generate an allele, *ust42* (Figures S1A) (Chen et al., 2014). *tm1019* lacks the MID domain of Argonaute proteins; however, the remainder of the protein is translated in frame. The alleles, *tm2401* and *ust42*, result in stop codons and are likely to be null alleles. *wago-4(ust42)* has been outcrossed twice and is used as the reference allele.

We confirmed that WAGO-4 is involved in dsRNA-induced gene silencing by feeding RNAi targeting a number of soma- and germline-expressed genes. RDE-4 is a dsRNA-binding protein which is indispensable for feeding RNAi. *rde-4* mutants were resistant to the RNAi targeting *pos-1, lir-1,* and *lin-15b* (Figure S1B). The nuclear Argonaute protein NRDE-3 was required for dsRNA targeting both *lir-1* and *lin-15b*, the two examples used in nuclear RNAi analysis (Guang et al., 2008). *wago-4* was required for exogenous RNAi targeting *pos-1* or *lin-15b*, but not for RNAi targeting *lir-1* gene. These data suggest that WAGO-4 is involved in dsRNA-induced gene silencing. Since *pos-1* is mainly silenced by RNAi in cytoplasm (Guang et al., 2008), these data also suggest that WAGO-4 could conduct gene silencing in the cytoplasm.

We further examined whether *wago-4* is required for the inheritance of RNAi (Figure 1A). We first used a germline-expressed *pie-1$_p$::gfp::h2b* (abbreviated as *h2b::gfp*) transgene as a reporter, which can inherit RNAi-induced gene silencing for multiple generations (Buckley et al., 2012). The nuclear Argonaute *hrde-1* was not required for exogenous *gfp* dsRNA to silence the *h2b::gfp* transgene in the parental generation but essential for the silencing in F1 generation (Figure 1B). Similarly, *wago-4* was not required for exogenous *gfp* dsRNA to silence the *h2b::gfp* transgene in the P0 generation, but was necessary for silencing in F1 progeny. Next we used a soma-expressed *sur-5::gfp* transgene as another reporter of RNAi inheritance. *sur-5::gfp* was silenced by exogenous *gfp* dsRNA in both P0 and F1 generations in wild-type animals (Figure 1C). In *wago-4* mutant animals, *sur-5::gfp* was silenced in P0 generation but desilenced in F1 generation, suggesting that the progeny failed to inherit the silencing effect. Interestingly, the fluorescence intensity of both *h2b::gfp* and *sur-5::gfp* transgenes did not reach the levels of untreated animals in *wago-4* mutants, suggesting the presence of a weak RNAi inheritance even in the absence of *wago-4* (Figures 1B and 1C). The *C. elegans'* genome encodes 27 Argonaute proteins, twelve of which belong to the WAGO clade (Yigit et al., 2006). We speculate that other WAGO proteins may function redundantly with WAGO-4 in mediating the inheritance of RNAi.

To further demonstrate that WAGO-4 promotes RNAi inheritance, we generated a single-copy WAGO-4 transgene *wago-4p::3xFLAG::GFP::WAGO-4* (abbreviated as *GFP::WAGO-4*) using MosSCI technology (Frokjaer-Jensen et al., 2014). This transgene rescued *pos-1* and *mex-5* dsRNA-elicited embryonic lethality and partially rescued *lin-15* dsRNA-induced Muv phenotype in *wago-4(ust42)* animals (Figures S1C-E), suggesting that the GFP::WAGO-4 represents the function and activity of endogenous WAGO-4 protein. *dpy-11* is an ortholog of human TMX1 and TMX4 genes and is required for body morphogenesis (Minkina and Hunter, 2017). dsRNA targeting *dpy-11* in *eri-1* parental animals induced a dumpy phenotype in the F1 progeny in the absence of further RNAi, suggesting that the RNAi signal has been

inherited (Figure 1D). While *rde-4* animals did not respond to feeding RNAi at all, the depletion of NRDE-3 or WAGO-4 both caused the loss of dumpy phenotype in F1 animals, suggesting that NRDE-3 and WAGO-4 were required for the inheritance of RNAi-targeting somatic genes. The introduction of GFP::WAGO-4 transgene rescued the inheritance defects in *wago-4* mutants (Figure 1D), which confirmed the role of WAGO-4 in RNAi inheritance.

WAGO-4 is a germline-expressed Argonaute protein and required for the silencing of germline-expressed genes.

We downloaded the expression data of *wago-4* from Wormbase (version WS260). *wago-4* was exclusively detected in the hermaphrodite germline but not in the soma (Figure 2A). Consistently, GFP::WAGO-4 was exclusively expressed in the germline and all oocyte cells in gravid adults in hermaphrodites but not significantly expressed in the male germline (Figures 2B and S2A). In early embryos, WAGO-4 is expressed in the P1 and EMS cells (Figure S2B). In late embryos, WAGO-4 was exclusively expressed in Z2/Z3 cells. Interestingly, we observed that WAGO-4 accumulated at some distinct perinuclear foci (Figure 2B). Many RNA processing and regulatory factors, including the RNAi machinery, are enriched in the perinuclear region and exhibit distinct foci, which are termed P-granules (Chen et al., 2016; Claycomb et al., 2009; Gu et al., 2009; Tu et al., 2015; Wedeles et al., 2013). We crossed *GFP::WAGO-4* with a chromatin marker strain *mCherry::H2B* and the P-granule marker strain *mRuby::PGL-1* respectively and found that WAGO-4 partially co-localized with the P-granule marker PGL-1 but not with the chromatin marker (Figure 2C).

WAGO-4 lacks the DDH catalytic triad of amino acids considered necessary for Argonaute-based slicer activity (Yigit et al., 2006). We tested whether WAGO-4 was required for RNAi targeting germline-expressed mRNAs. We fed L1 animals on dsRNA, harvested L4 animals of the same generation 48 hours later, and quantified mRNA levels by real-time PCR. We found that WAGO-4 was required for the

decrease of the targeted mRNAs (Figure 2D), suggesting that either WAGO-4 contains some slicer activity, or siRNA/WAGO-4 complex silences targeted mRNAs through other mechanisms. Interestingly, *mex-5* and *pos-1* mRNAs were not fully desilenced in *wago-4* mutants, suggesting that other germline Argonaute proteins may function redundantly with WAGO-4 to silence germline genes.

WAGO-4 and HRDE-1 act differently in promoting RNAi inheritance.

Both HRDE-1 and WAGO-4 are required for the inheritance of RNAi, yet they exhibit distinct subcellular locations. We hypothesized that they function via different mechanisms or at distinct steps in the process of transmitting siRNAs and/or re-establishing the silencing effects in the progeny.

To test this hypothesis, we fed *sur-5::gfp* parental animals with *gfp* dsRNA and examined *gfp* expression in F1 embryos and L4 larva without further feeding RNAi. *sur-5::gfp* was silenced in wild-type animals but not in *rde-1* mutants in the parental and F1 animals (Figures 3A and S3). In *hrde-1* and *nrde-1/2/4* mutants, *sur-5::gfp* was silenced in both parent animals and F1 embryos, indicating that the animals defective for nuclear RNAi are able to inherit *gfp* silencing signals. During larval development, the heritable *gfp* silencing was relieved in *nrde-1/2/4* mutants (Figure S3), which was also shown in *nrde-3* mutants previously (Burton et al., 2011). However, *hrde-1(-)* mutants still exhibited gene silencing in L4 larva in the soma, further supporting that *hrde-1(-)* animals inherited silencing signals (Figures 3A and S3). Strikingly, when *wago-4(-);sur-5::gfp* animals were fed with *gfp* dsRNA, the *sur-5::gfp* was expressed in both F1 embryos and L4 larva (Figure 3A), although not to the levels of the *rde-1* mutant. These results suggest that WAGO-4 is likely engaged in transmitting small RNAs from the parents to zygotes or at least at an earlier step than HRDE-1 to re-establish the silencing state in the progeny.

Previous genetic screens failed to identify WAGO proteins other than HRDE-1 that was required to mediate the inheritance of RNAi targeting *h2b::gfp* transgene

(Buckley et al., 2012). The identification of WAGO-4 in RNAi inheritance suggested that these WAGO proteins should be re-investigated individually. We selected three other Argonaute proteins, in which C04F12.1 is closest to CSR-1, WAGO-10 is closest to HRDE-1, and PPW-2 is closest to WAGO-4 based on sequence comparison (Gu et al., 2009). However, none of these three proteins was required for the inheritance of RNAi targeting the *h2b::gfp* transgene (Figure 3B). This data suggests that either WAGO-4 and the nuclear Argonaute HRDE-1 and NRDE-3 played special roles in RNAi inheritance, or C04F12.1, WAGO-10, and PPW-2 exhibit functional redundancy (Shirayama et al., 2012).

WAGO-4 acts in multigenerational inheritance of RNAi.

To test whether *wago-4* is required for multigenerational inheritance of RNAi, we fed germline-expressed *h2b::gfp* animals with *gfp* dsRNA and scored *gfp* levels in later generations. The *h2b::gfp* transgene was silenced in the parental generation and the silencing was maintained to F1 and F2 generations, although at reduced levels (Figure 4A). Both *hrde-1* and *wago-4* were required for the inheritance of *gfp* silencing to F1 and F2 generations.

Then we fed GFP::WAGO-4 animals with dsRNA targeting *oma-1* only in P0 generation and isolated WAGO-4-bound siRNAs in later generations, followed by small RNA deep sequencing. WAGO-4 bound to *oma-1* siRNAs not only in the P0 and F1 generations, but also in the F3 generation (Figures 4B and 4C), suggesting that WAGO-4 act in multigenerational inheritance of RNAi.

Many RNAi inheritance mutants, including *hrde-1*, exhibit a Mrt phenotype that gradually loses the fertility along generations (Buckley et al., 2012; Spracklin et al., 2017). We compared the Mrt phenotype of *hrde-1* and *wago-4* animals by examining their brood size at 25℃ (Figure 4D). While *hrde-1* animals gradually lost the fecundity and achieved sterility at F3/F4 generations, *wago-4* animals exhibited a weaker Mrt phenotype and got sterile at the F8/F9 generations.

WAGO-4 binds to 22G-RNAs that target germline-expressed protein coding genes.

To better understand the functions of WAGO-4, we immunoprecipitated WAGO-4 from gravid P0 animals before and after exogenous *lin-15b* RNAi, purified WAGO-4-associated mRNAs, and quantified mRNAs by real-time PCR. We found that WAGO-4 bound to *lin-15b* mRNA after *lin-15b* RNAi (Figures S4A and 5A), suggesting that WAGO-4 can be directed to targeted mRNAs by exogenous dsRNA. We then deep-sequenced WAGO-4-associated small RNAs in a 5'-phosphate-independent manner (Zhou et al., 2014). Small RNA reads were aligned to the *C. elegans* transcriptome (WS243 assembly), and the number of reads targeting each gene was counted. WAGO-4 preferentially binds to small RNAs antisense to *lin-15b* mRNA in the presence of exogenous *lin-15b* dsRNA (Figure 5B). Although most of the reads locate inside the dsRNA region, a portion of siRNAs are derived from outside of the dsRNA region (Figure 5C). *lin-15b* and *lin-15a* localize in an operon and are transcribed as a single pre-mRNA, spliced in the nucleus, and exported individually into the cytoplasm. The siRNAs targeting *lin-15a* were not increased, which is consistent with the idea that RNA dependent RNA polymerases (RdRPs) use mRNAs in the cytoplasm, but not pre-mRNAs in the nucleus, as templates to amplify secondary siRNAs, and suggests that WAGO-4 bound to secondary siRNAs (Pak and Fire, 2007).

We further characterized WAGO-4-associated endogenous siRNAs. WAGO-4-associated endogenous siRNAs were 22 nt in length (Figure 5D), and the vast majority of the siRNAs started with G or GA at their 5' ends (Figures 5D and S4B), which are consistent with the properties of 22G-RNA. Approximately 93% of WAGO-4-bound 22G-RNAs target protein-coding genes (Figure 5E). We selected potential WAGO-4 targets that had greater than 25 reads per million and identified 4,774 genes (Table S1).

We then compared WAGO-4-bound 22G-RNAs to other siRNA categories (Gu et al., 2009; Tu et al., 2015; van Wolfswinkel et al., 2009). Consistent with its germline expression, WAGO-4 targets exhibited a pronounced overlap with *glp-4*-dependent genes (Figure 5F). Although WAGO-1, WAGO-4, and CSR-1 are all expressed in germline, WAGO-4 targets dramatically overlapped with those of CSR-1 but not WAGO-1, suggesting that WAGO-4 and CSR-1 may regulate the same cohorts of protein-coding genes in the germline. However, although *csr-1* mutant is homozygous lethal and exhibits chromosomal segregation defects (Claycomb et al., 2009; Gerson-Gurwitz et al., 2016), *wago-4* animals are largely normal and have similar brood size to that of wild-type animals at 20℃ (Figure S4C). We quantified the mRNA levels of WAGO-4 targets, but failed to detect pronounced desilencing of the mRNA levels in *wago-4* mutants compared to wild-type animals (Figure S4D). These data suggest that CSR-1 and WAGO-4 may function differently in gene regulation and animal development, although they bind to the same cohorts of germline-expressed 22G-RNAs.

WAGO-4-associated 22G-RNAs contain untemplated 3'-end uridylation.

We analyzed the 3'-ends of WAGO-4-associated 22G-RNAs and found that approximately 7.6% of them contained untemplated addition of a uracil (Figure 6A). For reads longer than 23 nt, approximately 31% of them contained an extra U and 24.5% contained extra UU dinucleotides. We then examined the nucleotide distribution at each position (Figure S5A). Although the first two nucleotides exhibit a strong propensity towards the GA dinucleotide sequence and the nucleotides at position 3 to 5 have a modest enrichment of A, the four nucleotides (A, U, C, and G) are approximately equally distributed at each position in the middle of 22G-RNAs in wild type animals. At the 3'-end, WAGO-4-associated 22G-RNAs exhibited a strong representation towards U.

CDE-1 is a polyuracil polymerase that adds untemplated uracils to 22G-RNAs (van Wolfswinkel et al., 2009). We examined whether CDE-1 is involved in

uridylating WAGO-4-associated 22G-RNAs by deep sequencing WAGO-4-associated small RNAs from *cde-1(tm1021);3xFLAG::GFP::WAGO-4* animals. The vast majority of WAGO-4-associated 22G-RNAs still targeted protein-coding genes (Figure S5B) and exhibited a tendency towards GA at 5'-end (Figure S5A), suggesting that CDE-1 is not essential for the biogenesis of WAGO-4-associated siRNAs. Yet the untemplated addition of uracil was decreased in *cde-1* mutants. The percentage of an extra U was 7.6% in wild type animals and 2.5% in *cde-1* animals (Figure 6B). For reads longer than 23 nt, the percentage of an extra U was 31% in wild type animals and 19% in *cde-1* animals respectively (Figure 6C).

Noticeably, in *cde-1* mutants, WAGO-4 bound approximately 24-fold more antisense ribosomal siRNAs (risiRNA) (31,409 reads per million in *cde-1* vs. 1,322 reads per million in wild-type animals) and 22-fold more small RNAs related to splicing leaders (Figure S5B). We re-analyzed the published deep sequencing data sets and identified similar increase of risiRNAs in *cde-1* mutants (data not shown) (van Wolfswinkel et al., 2009). How CDE-1 is involved in risiRNA biogenesis remains unclear (Zhou et al., 2017).

CDE-1-mediated uridylation is thought to destabilize CSR-1-bound 22G-RNAs (van Wolfswinkel et al., 2009). We re-analyzed published data of small RNAs associated with CSR-1 in *cde-1* and wild-type animals (van Wolfswinkel et al., 2009). CSR-1 targets with greater than 25 reads per million were selected. As reported, CSR-1 bound more 22G-RNAs of CSR-1 targets in the *cde-1* mutant (Figure 6D). In contrast, WAGO-4 bound fewer 22G-RNAs of WAGO-4 targets in the *cde-1* mutant (Figure 6E). Previous studies suggested that there exists a loading balance between WAGO pathway and CSR-1 pathway, which can be regulated by CDE-1 mediated uridylation (de Albuquerque et al., 2015; Phillips et al., 2015; van Wolfswinkel et al., 2009). We selected WAGO-4-associated 22G-RNAs that were decreased 2-fold and CSR-1-associated 22G-RNAs that were increased 2-fold in the *cde-1* mutant, and found that 1,344 genes were decreased in WAGO-4 binding but simultaneously

increased in CSR-1 binding (Figure 6F). These data suggest that CDE-1-engaged uridylation likely stabilizes the binding of 22G-RNAs to WAGO-4 but destabilizes the binding to CSR-1.

We then asked whether *cde-1* is required for the inheritance of RNAi. Consistent with a recent report, *cde-1* was not required for exogenous dsRNA to silence the germline-expressed *h2b::gfp* transgene in the parental generation but was imperative for silencing in F1 progeny (Figure S5C) (Spracklin et al., 2017). Taken together, we hypothesize that CDE-1 mediates RNAi inheritance by uridylating WAGO-4-bound 22G-RNAs.

WAGO-4 promotes the transmission of siRNAs for RNAi inheritance.

We hypothesized that WAGO-4 is able to directly transmit siRNAs from parents to progeny. Three lines of evidence cumulatively supported this idea. First, WAGO-4 was expressed in both germline cells and oocytes (Figures 2B and 7A). In -3 to -1 oocytes, WAGO-4 still exhibited distinct foci, but changed localization from peri-nuclear region to cytoplasm. Second, WAGO-4 is expressed in one-cell embryos (Figure 7B). Early in the one-cell stage before chromosomal alignment, WAGO-4 is evenly distributed in the zygote without pronounced aggregation. After chromosomal alignment, WAGO-4 began to accumulate in P-granule foci at the posterior ends. The expression of WAGO-4 in -1 oocyte and the one-cell embryos suggest that WAGO-4 is able to carry siRNAs from parents to progeny.

Third, we used the subcellular localization of GFP::NRDE-3 as a reporter of siRNA abundance to test whether the germline-expressed WAGO-4 is required for the siRNA accumulation in the soma in the progeny. NRDE-3 is a somatic Argonaute protein that localizes to the nucleus when it binds to siRNAs. In *eri-1* animals, NRDE-3 accumulates in the cytoplasm in the absence of siRNA binding (Guang et al., 2008). In *eri-1;GFP::NRDE-3,* but not *eri-1;wago-4;GFP::NRDE-3,* animals, feeding RNAi targeting soma-expressed *dpy-11* and *lin-15b* genes elicited a

cytoplasm-to-nucleus translocation of GFP::NRDE-3 in the F1 embryos (Figure 7C). Since the presence of mRNA templates were required for the amplification of secondary siRNAs, the siRNAs targeting soma-expressed genes (*dpy-11* and *lin-15b*) were unable to be amplified in the germline. The fact that the inheritance of RNAi targeting somatic genes depended on the germline-expressed WAGO-4 suggested that siRNAs were likely transmitted from the parental germline to progeny embryos by WAGO-4. These siRNAs were then transported from the germline to soma to be amplified and induced cytoplasm-to-nucleus translocation of NRDE-3.

Taken together, these data suggest that WAGO-4 may directly promote the transmission of siRNAs from the parents to the progeny.

Discussion:

The inheritance of RNAi in *C. elegans* results from multiple steps, including initiation, transmission and re-establishment of silencing. Here, we demonstrated that the cytoplasmic Argonaute protein WAGO-4 and the poly(U) polymerase CDE-1 play important roles in promoting inheritance of RNAi.

WAGO-4 promotes RNAi inheritance.

The nuclear RNAi pathway has been shown to play essential roles in transgenerational inheritance of RNAi (reviewed by (Heard and Martienssen, 2014; Rechavi and Lev, 2017). Here, we demonstrated that WAGO-4 promotes the inheritance of RNAi. WAGO-4 partially localized to the perinuclear P-granule foci, suggesting that cytoplasmic RNAi machinery is also involved in the inheritance of RNAi. P-granules contain numerous RNA processing and regulatory factors, including a few WAGOs (Chen et al., 2016). In a recent genetic screen, Spracklin et al. identified two cytoplasmic proteins GLH-1/VASA and HRDE-2 in transgenerational inheritance of RNAi (Spracklin et al., 2017), further supporting that the cytoplasmic factors are indispensable for the inheritance of RNAi. Previously, the cytoplasmic Argonaute protein WAGO-1 has been implicated in the maintenance of silencing

(Shirayama et al., 2012). Yet another study showed that WAGO-1 is not required for RNAi inheritance of a *pie-1*$_p$*::gfp::h2b* transgene (Buckley et al., 2012). Therefore, a systematic investigation of the function of WAGO-1 in RNAi inheritance is needed.

Our data suggest that WAGO-4 is involved in the transmission of siRNAs from the parents to progeny. First, WAGO-4 is expressed in both -1 oocyte and the one-cell embryos, suggesting that WAGO-4 is able to carry 22G-RNAs from the parental oocyte to the progeny. Second, using the subcellular localization of GFP::NRDE-3 as a siRNA reporter, we showed that the germline expressed Argonaute protein WAGO-4 is required for the production of siRNAs in the soma. A working model of RNAi inheritance was shown in Figure 7D.

Epigenetic changes can arise in the F1 embryos that are present inside the parents when the parental animals are exposed to environmental stimuli. These phenomena can be called as parental effects or intergenerational epigenetic inheritance (Anava et al., 2014; Heard and Martienssen, 2014; Houri-Zeevi and Rechavi, 2017). The epigenetic changes that are inherited and maintained for more than two or three generations are then called transgenerational inheritance. Stable maintenance of silencing requires an additional class of siRNAs that must be amplified in each generation. These siRNAs can be classified as secondary or tertiary siRNAs (Sapetschnig et al., 2015). WAGO-4 binds to siRNAs in F3 generation after initial RNAi, suggesting that WAGO-4 is engaged in transgenerational inheritance of RNAi and binds to secondary and tertiary siRNAs.

WAGO-4- and CSR-1-associated 22G-RNAs target similar cohorts of germline-expressed protein-coding genes. However, *csr-1* mutant is homozygous lethal, while *wago-4* mutants are largely normal when grew at 20℃, suggesting that these two Argonaute proteins may use different gene regulatory mechanisms (Shirayama et al., 2012). Interestingly, although WAGO-4 lacks the DDH catalytic

triad of amino acids considered necessary for Argonaute-based slicer activity (Yigit et al., 2006), it was required for the silencing of the targeted mRNAs.

Untemplated uridylation by CDE-1 is required for RNAi inheritance.

An important question is how Argonaute proteins selectively identify and bind to their siRNA ligands from a pool of short nuclear acids in the cell. In *Arabidopsis,* the 5' terminal nucleotide directs the sorting of small RNAs into different Argonaute complexes (Mi et al., 2008; Montgomery et al., 2008; Takeda et al., 2008). In *C. elegans*, 22G-RNAs may be sorted to distinct Argonaute proteins upon target recognition. Here, our data suggested that untemplated uridylation at the 3'-ends may function as an additional sorting signal by modulating the binding affinity of 22G-RNAs to different Argonaute proteins (de Albuquerque et al., 2015; Phillips et al., 2015; van Wolfswinkel et al., 2009). Alternatively, uridylation of 22G-RNAs may change their binding affinity to only one Argonaute, while more or less of the rest 22G-RNAs bind to the other Argonaute proteins.

The poly(U) polymerase CDE-1 (also known as PUP-1 and CID-1) adds untemplated uracil to the 3' termini of RNAs in *C. elegans* (Kwak and Wickens, 2007; van Wolfswinkel et al., 2009). Previous studies suggested that a small RNA loading balance between WAGO pathway and CSR-1 pathway may exist, which is regulated by CDE-1 mediated uridylation (de Albuquerque et al., 2015; Phillips et al., 2015; van Wolfswinkel et al., 2009). Because CDE-1 interacts with a RNA-dependent RNA polymerase EGO-1, but not with the Argonaute protein CSR-1 (van Wolfswinkel et al., 2009), and EGO-1 is required for the production of 22G-RNAs and acts upstream of the loading of 22G-RNAs to Argonaute proteins, we speculated that uridylation happens upstream of small RNA loading to Argonaute proteins in *C. elegans*. Interestingly, in fission yeast, the uridyl transferase Cid16 can add non-templated nucleotides to Argonaute-bound small RNAs *in vitro* (Pisacane and Halic, 2017). Thus we could not exclude the possibility that CDE-1 might be able to uridylate Argonaute-bound siRNAs after loading, since we were only measuring the steady

state levels of Argonaute-bound siRNAs by immunoprecipitation from worm extracts. Further *in vitro* biochemical experiments are required to examine the binding affinities of uridylated 22G-RNAs to different Argonaute proteins and how 3' uridylation affects the stability and target recognition of small RNAs.

Noticeably, Spracklin et al. identified that CDE-1 is required for the inheritance of RNAi (Spracklin et al., 2017), for which the mechanism is not fully understood. Our data suggest that CDE-1 may mediate RNAi inheritance by regulating the binding of 22G-RNAs to WAGO-4. Yet *cde-1* mutants exhibited a weaker inheritance defects than *wago-4* animals. Therefore, the function of CDE-1 in RNAi inheritance needs further investigation.

Experimental Procedures:

Strains. Bristol strain N2 was used as the standard wild-type strain. All strains were grown at 20°C. The strains used in this study are listed in Supplemental Experimental Procedures.

RNAi. RNAi experiments were conducted as described previously (Timmons et al., 2001). HT115 bacteria expressing the empty vector L4440 (a gift from A. Fire) were used as controls. Bacterial clones expressing dsRNA were obtained from the Ahringer RNAi library (Kamath et al., 2003) and were sequenced to verify their identities. *lin-15b* RNAi clones were described previously (Guang et al., 2008).

RNAi inheritance assay. Synchronized L1 animals of the indicated genotypes were exposed to bacteria expressing *gfp* dsRNA. F1 embryos were collected by hypochlorite/NaOH treatment and grown on HT115 control bacteria. The expression levels of GFP in both parental generation and progeny were visualized and scored.

Images were collected on Leica DM2500 microscope. For the quantitation of GFP

intensity, the average fluorescence intensities of L4 worms (0.5-second exposure) and embryos (1-second exposure) were analyzed using ImageJ (Borges and Martienssen, 2015). The background of each individual animal was subtracted using "the rolling ball radius" model of 3x3 pixels with the smoothing feature disabled. For subcellular localization analysis, approximately ten germlines were imaged and analyzed by ImageJ.

Images of co-localization analysis were collected on Leica DM4 B microscope system.

Mrt assay.

wago-4(ust42)(2x) was successively outcrossed twice with N2 animals to get *wago-4(ust42)(4x)* before conducting Mrt experiments. Twenty larval stage L3 animals were singled onto OP50 plates at each generation and cultured at 25℃. The average brood size at each generation was calculated.

Construction of plasmids and transgenic strains.

For 3xFLAG::GFP::WAGO-4, the 3xFLAG::GFP coding region was PCR amplified from plasmid pSG085 with the primers 5′-AGCTCTTCCTATGGACTACAAAGACCATGAC-3' and 5′-ATAGCTCCACCTCCACCTCCTTTGTATAGTTCATCCATGCC -3′. The predicted *wago-4* promoter was amplified from N2 genomic DNA with primers 5'-CGTGGATCCAGATATCCTGCAGGTTCGGTTACGCTCTCTCTCCAG -3′ and 5'-TGTAGTCCATAGGAAGAGCTGGCATCCTTCTC -3′. The *wago-4* coding region and predicted 3' UTR were then amplified by PCR from N2 genomic DNA with primers 5'-GGAGGTGGAGGAGGTGGAGCTATGCCAGCTCTTCCTCCAGTC-3' and 5'-GACTCACTAGTGGGCAGATCTCATCCCTGATGCCAAGCCGAC-3'. The plasmid pCFJ151 was digested with *Sbf*I and *Bgl*II. The three above PCR fragments were cloned into linearized pCFJ151 with the ClonExpress MultiS One Step Cloning

kit (Vazyme C113-02) to generate a 3xFLAG::GFP::WAGO-4 fusion gene. The transgene was then integrated into the *C. elegans* genome using the mos1-mediated single copy insertion (MosSCI) method (Frokjaer-Jensen et al., 2014).

Dual sgRNA-directed *wago-4* deletion. Dual sgRNA-guided chromosome deletion was conducted as previously described (Chen et al., 2014). We manually searched for target sequences consisting of G(N)19NGG near the desired mutation sites in N2 genomic region. We replaced the *unc-119* target sequence in the pU6::unc-119 sgRNA vector with the desired target sequence using overlapped extension PCR with primer pairs sgRNA-1F: 5'-GAAGATCCGCTCATGGTCAAGTTTTAGAGCTAGAAATAGCAAGTTA-3' and sgRNA-1R: 5'-CATGAGCGGATCTTCAAACATTTAGATTTGCAATTCAATTATATAG-3'; sgRNA-2F: 5'-GAATATTGCACCCGGTATTTGTTTTAGAGCTAGAAATAGCAAGTTA-3' and sgRNA-2R: 5'-CCGGGTGCAATATTCAAACATTTAGATTTGCAATTCAATTATATAG-3'; sgRNA-3F: 5'-GTTCAGAGAAGGCGCAGTAAGTTTTAGAGCTAGAAATAGCAAGTTA-3' and sgRNA-3R: 5'-GCGCCTTCTCTGAACAAACATTTAGATTTGCAATTCAATTATATAG-3'. Plasmid mixtures containing 50 ng/µl each of pU6::wago4 sgRNA1-3, 50 ng/µl Cas9 expression plasmid, 5 ng/µl pCFJ90 and 5 ng/µl pCFJ104 were co-injected into N2 animals. The deletion mutants were screened by PCR.

Quantitative RT-PCR. RNAs were isolated from indicated animals using a dounce homogenizer (pestle B) in TRIzol solution followed by DNase I digestion (Qiagen), as described previously (Guang et al., 2008). cDNAs were generated from RNAs using the iScript cDNA Synthesis Kit (Bio-Rad) according to the vendor's protocol. qPCR was performed using a MyIQ2 real-time PCr system (Bio-Rad) with iQ SYBR

Green Supermix (Bio-Rad). The primers that were used in qRT-PCR are provided in Supplemental Experimental Procedures. *eft-3* mRNA was used as an internal control for sample normalization. Data analysis was performed using a ΔΔCT approach.

RNA immunoprecipitation (RIP). RIP experiments were performed as previously described with adult animals (Guang et al., 2008). Briefly, gravid adults were sonicated in sonication buffer (20 mM Tris-HCl [pH 7.5], 200 mM NaCl, 2.5 mM MgCl2, and 0.5% NP-40). The lysate was pre-cleared with protein G-agarose beads (Roche) and incubated with anti-FLAG M2 agarose beads (Sigma #A2220). The beads were washed extensively and 3xFLAG::GFP::WAGO-4 and its associated RNAs were eluted with 100 μg/ml 3xFLAG peptide (Sigma). The eluates were incubated with TRIzol reagent followed by isopropanol precipitation. WAGO-4-bound RNAs were quantified by real-time PCR.

Isolation and sequencing of WAGO-4-associated small RNAs. WAGO-4-associated siRNAs were isolated from gravid adults as described above. The precipitated RNAs were treated with calf intestinal alkaline phosphatase (CIAP, Invitrogen), re-extracted with TRIzol, and treated with T4 polynucleotide kinase (T4 PNK, New England Biolabs) in the presence of 1 mM ATP (Zhou et al., 2014).

WAGO-4-bound siRNAs were subjected to deep sequencing using an Illumina platform, according to the manufacturer's instructions by the Beijing Genomics Institute (BGI Shenzhen). Small RNAs ranging from 18 to 30 nt were gel-purified and ligated to a 3' adaptor (5'-pUCGUAUGCCGUCUUCUGCUUGidT-3'; p, phosphate; idT, inverted deoxythymidine) and a 5' adaptor (5'-GUUCAGAGUUCUACAGUCCGACGAUC-3'). The ligation products were gel-purified, reverse transcribed, and amplified using Illumina's sRNA primer set (5'-CAAGCAGAAGACGGCATACGA-3'; 5'-AATGATACGGCGACCACCGA-3'). The samples were then sequenced using an Illumina Hiseq platform.

The Illumina-generated raw reads were first filtered to remove adaptors, low-quality tags and contaminants to obtain clean reads at BGI Shenzhen. Clean reads ranging from 18 to 30 nt were mapped to the unmasked *C. elegans* genome and the transcriptome assembly WS243, respectively, using Bowtie2 with default parameters (Langmead and Salzberg, 2012). The number of reads targeting each transcript was counted using custom Perl scripts and displayed by IGV (Thorvaldsdottir et al., 2013). The number of total reads mapped to the genome minus the number of total reads corresponding to sense rRNA transcripts (5S, 5.8S, 18S, and 26S) was used as the normalization number to exclude the possible degradation fragments of sense rRNAs.

Statistics: Bar graphs with error bars were presented with mean and s.d.. All the experiments were conducted with independent *C. elegans* animals for indicated times. Statistical analysis was performed with two-tailed Student's t-test.

Data availability: Argonaute-associated small RNAs from published data were re-analyzed. CSR-1 IP in wild type animals and in *cde-1* mutants, GSE17787 (van Wolfswinkel et al., 2009); WAGO-1 IP, SRR030711 (Gu et al., 2009); *glp-4(bn2)*, GSM455394 (Gu et al., 2009); WAGO-4 IP, GSE112475.

All other data and materials are available upon request.

Acknowledgments

We are grateful to Dr. Scott Kennedy and members of the Guang lab for their comments. We are grateful to Dr. Ho Yi Mak, the International *C. elegans* Gene Knockout Consortium, and the National Bioresource Project for providing the strains. Some strains were provided by the CGC, which is funded by NIH Office of Research Infrastructure Programs (P40 OD010440). This work was supported by grants from the Chinese Ministry of Science and Technology (2017YFA0102903), the National Natural Science Foundation of China (Nos. 81501329, 31671346, and 91640110), Anhui Natural Science Foundation (No. 1608085MC50), and the Major/Innovative

Program of Development Foundation of Hefei Center for Physical Science and Technology (2017FXZY005).

Author Contributions

F. X., X. F. and S. G. designed the experiments, F. X., X. F., X. C., C. W., Q. Y., T. X., and M. H. performed experiments. F. X., X. F. and S. G. analyzed the data. F. X., X. F. and S. G. wrote the manuscript. All authors have discussed the manuscript.

Additional Information

The authors declare no competing financial interests.

Supplemental Information

Supplemental Information includes Supplemental Experimental Procedures, five figures (Figures S1-S5), and one table.

Table S1. WAGO-4-associated siRNAs targeted genes, Related to Figure 5

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Figure Legends:

Figure 1: WAGO-4 is required for the inheritance of RNAi. (a) A scheme of RNAi procedures. (b) *pie-1$_p$::gfp::h2b* and (c) *sur-5::gfp* transgenic animals were exposed to bacteria expressing *gfp* dsRNA, respectively. F1 embryos were isolated and grown on control bacteria in the absence of further *gfp* dsRNA treatment. GFP expression was imaged (upper panel) and the levels were scored (lower panel). (d) Rescue assay with the GFP::WAGO-4 transgene. The indicated animals were treated with *dpy-11* dsRNA and F1 animals were transferred to control bacteria (upper panel). The levels of dumpyness were scored (lower panel). ***p<0.001.

Figure 2: WAGO-4 is a germline-expressed Argonaute protein. (a) The expression levels of *wago-4* mRNA at different developmental stages. Data were downloaded from Wormbase (version WS260). EE, early embryos; LE, late embryos; YA, young adults. (b) Images of the germline of the GFP::WAGO-4 strain. (c) Pachytene germ cells of GFP::WAGO-4 and the chromatin marker H2B::mCherry and P-granule marker mRuby::PGL-1 were imaged. (d) Wild-type and *wago-4(-)* animals were treated with indicated dsRNAs. Total RNAs were isolated at L4 stage of P0 generation and the indicated mRNAs were quantified by real-time PCR. mean ± s.d. n=3. *p<0.05, **p<0.01, ***p<0.001, ns, not significant.

Figure 3: WAGO-4 and HRDE-1 act differently to promote RNAi inheritance. (a) Images of indicated animals after *gfp* RNAi. *sur-5::gfp* animals were fed on *gfp* dsRNA and the F1 embryos were incubated on control bacteria. Upper panel: fluorescent images of indicated animals after *gfp* RNAi. Bottom panel: GFP intensity levels of the indicated animals were measured by ImageJ. The number of animals assayed is indicated. *p<0.05, **p<0.01, ***p<0.001, ns, not significant. (b) Images of germline cells of indicated animals. *h2b::gfp* animals were fed on *gfp* dsRNA and the F1 embryos were incubated on HT115 control bacteria. The *gfp* levels were scored and shown in the lower panel.

Figure 4. WAGO-4 acts in multigenerational inheritance of RNAi. (a) *pie-1*$_P$*::gfp::h2b* transgenic animals were exposed to bacteria expressing *gfp* dsRNA. F1 and F2 embryos were isolated and grown on control bacteria in the absence of further *gfp* dsRNA treatment. Percentage of F1 animals expressing GFP was counted (N>50). (b) WAGO-4-associated small RNAs targeting *oma-1* locus is shown. Red ticks are sense reads to *oma-1* sequence, blue ticks are antisense reads. GFP::WAGO-4 animals were treated with *oma-1* dsRNA at P0 generation and then fed on control bacteria in subsequent generations. GFP::WAGO-4 was immunoprecipitated from young adult animals and the associated small RNAs were deep sequenced. Animals fed on control RNAi bacteria were set as control. (c) Normalized number of antisense reads of indicated animals. (d) Brood size of indicated animals by Mrt assay at 25℃. N=20, mean±s.d..

Figure 5: WAGO-4 binds to 22G-RNAs that target germline-expressed protein coding genes. (a) WAGO-4 was immunoprecipitated at young gravid stage after *lin-15b* RNAi, and the associated RNAs were quantified by real-time PCR. mean ± s.d. n=3. (b) WAGO-4 was immunoprecipitated at young gravid stage, and the associated siRNAs were deep sequenced. The number of reads were normalized and then compared. (c) Reads targeting *lin-15b/a* genomic loci were plotted. Yellow box indicates the dsRNA-targeted region. (d) The length distribution and the first nucleotides of WAGO-4-associated siRNAs were analyzed. (e) WAGO-4-associated 22G-RNAs were grouped into different categories. (f) WAGO-4-associated 22G-RNAs were compared with other known siRNA categories.

Figure 6: CDE-1 uridylates WAGO-4-associated 22G-RNAs. (a) The untemplated 3'-end addition of nucleotides in WAGO-4-bound 22G-RNAs was analyzed. Left, total reads; right, reads longer than 23 nt. (b) Comparison of the untemplated addition of nucleotides in WAGO-4-associated 22G-RNAs in wild-type animals and *cde-1* mutants. The insert plot is a zoom-in of the main figure. (c) Comparison of the untemplated addition of nucleotides in WAGO-4-bound 22G-RNAs for reads longer

than 23 nt. (d) Analysis of CSR-1 22G-RNAs in *cde-1* mutants. (e) Analysis of WAGO-4 22G-RNAs in *cde-1* mutants. (f) Comparison of WAGO-4 and CSR-1 22G-RNAs in *cde-1* mutants. ***p<0.001.

Figure 7: WAGO-4 promotes transmission of siRNAs from parents to progeny. (a, b) Images of oocytes and early embryos of the *GFP::WAGO-4;mCherry::H2B* strain. (c) Images of F1 embryos of the indicated animals after feeding RNAi targeting L4 animals for 24 hours. The percentage of nuclear localized GFP::NRDE-3 in F1 embryos was indicated. The number of scored animals were indicated in the parentheses. N, nucleus. (d) A working model of WAGO-4-mediated inheritance of RNAi. WAGO-4 is involved in transmitting siRNAs along generations as well as conducting gene silencing in the germline. Inherited small RNAs targeting soma-expressed genes are translocated to the soma, amplified, and subsequently silence somatic gene expression. Inherited siRNAs targeting germline-expressed genes are amplified and silence gene expression in the germline of the progeny. WAGO-4 transmits germline siRNAs to the next generation and maintains the silencing status for multiple generations.

Figure 1

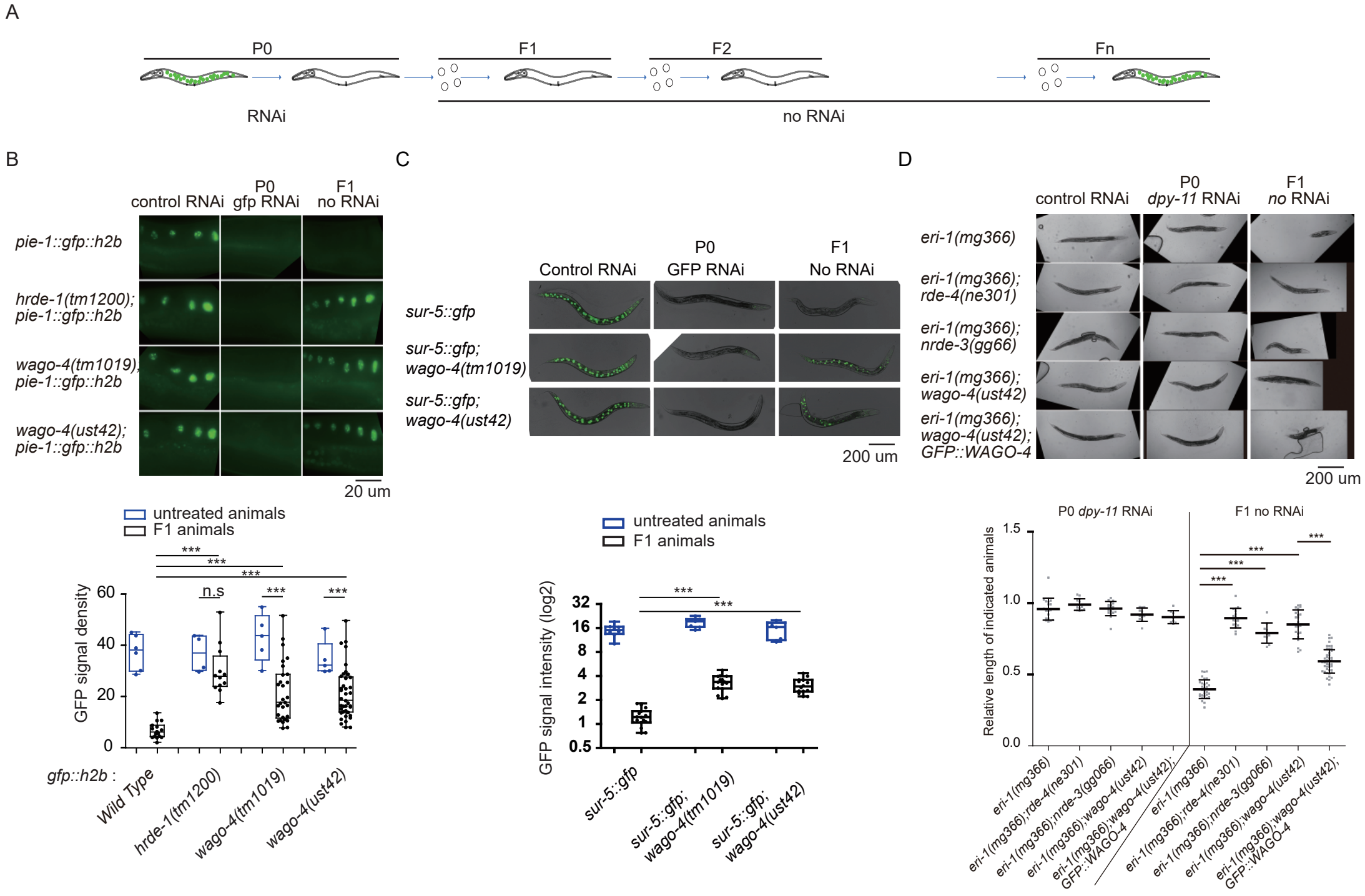

A
P0
F1
F2
Fn
RNAi
no RNAi
B
control RNAi
P0
gfp RNAi
F1
no RNAi
pie-1::gfp::h2b
hrde-1(tm1200);
pie-1::gfp::h2b
wago-4(tm1019);
pie-1::gfp::h2b
wago-4(ust42);
pie-1::gfp::h2b
20 um
C
Control RNAi
P0
GFP RNAi
F1
No RNAi
sur-5::gfp
sur-5::gfp;
wago-4(tm1019)
sur-5::gfp;
wago-4(ust42)
200 um
D
control RNAi
P0
dpy-11 RNAi
F1
no RNAi
eri-1(mg366)
eri-1(mg366);
rde-4(ne301)
eri-1(mg366);
nrde-3(gg66)
eri-1(mg366);
wago-4(ust42)
eri-1(mg366);
wago-4(ust42);
GFP::WAGO-4
200 um
untreated animals
F1 animals
GFP signal density
60
40
20
0
***
***
***
n.s
***
***
gfp::h2b :
Wild Type
hrde-1(tm1200)
wago-4(tm1019)
wago-4(ust42)
untreated animals
F1 animals
GFP signal intensity (log2)
32
16
8
4
2
1
0.5
***
***
sur-5::gfp
sur-5::gfp;
wago-4(tm1019)
sur-5::gfp;
wago-4(ust42)
P0 dpy-11 RNAi
F1 no RNAi
Relative length of indicated animals
1.5
1.0
0.5
0.0
***
***
***
***
eri-1(mg366)
eri-1(mg366);rde-4(ne301)
eri-1(mg366);nrde-3(gg066)
eri-1(mg366);wago-4(ust42)
eri-1(mg366);wago-4(ust42);
GFP::WAGO-4

Figure 2

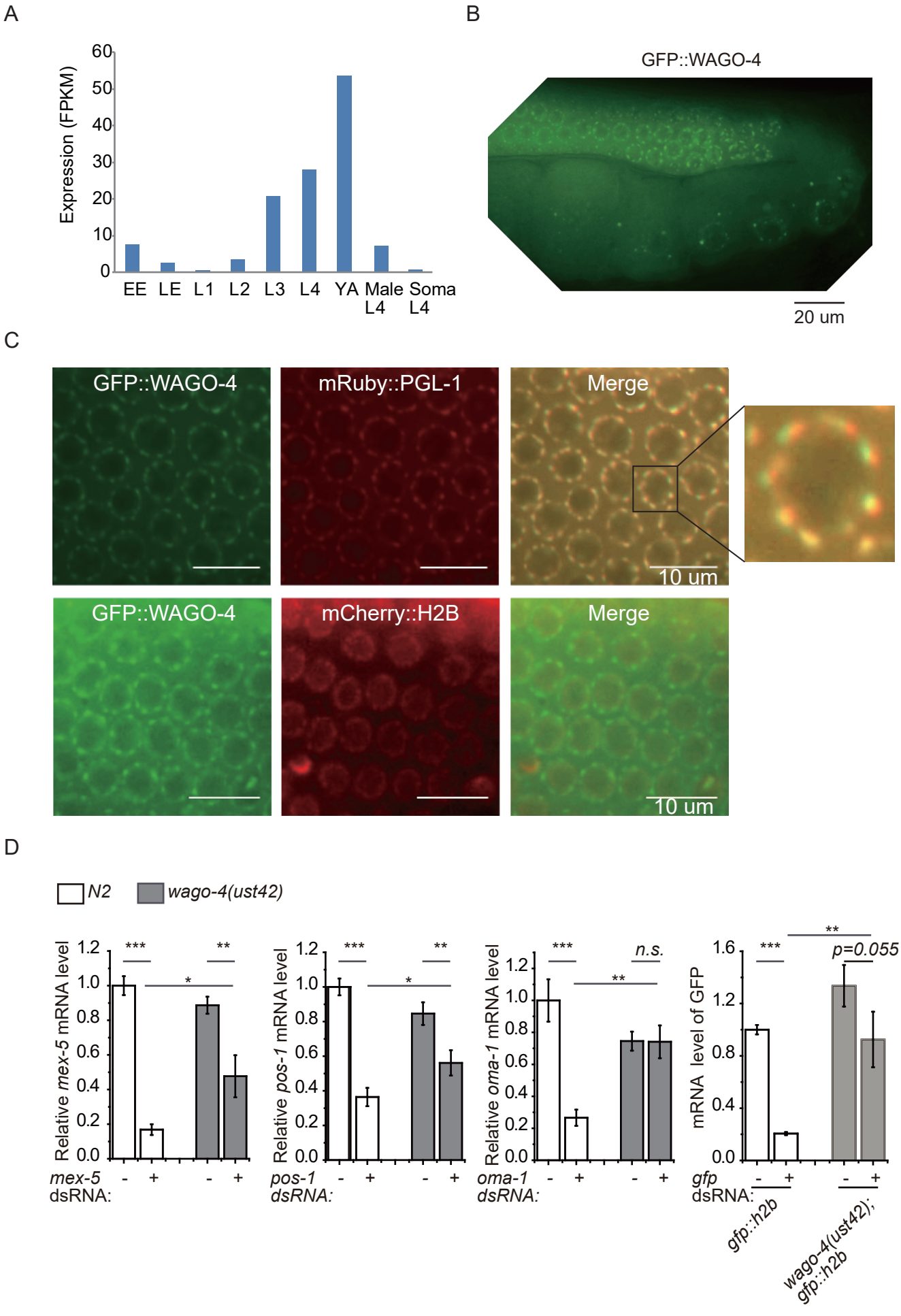


Figure 3

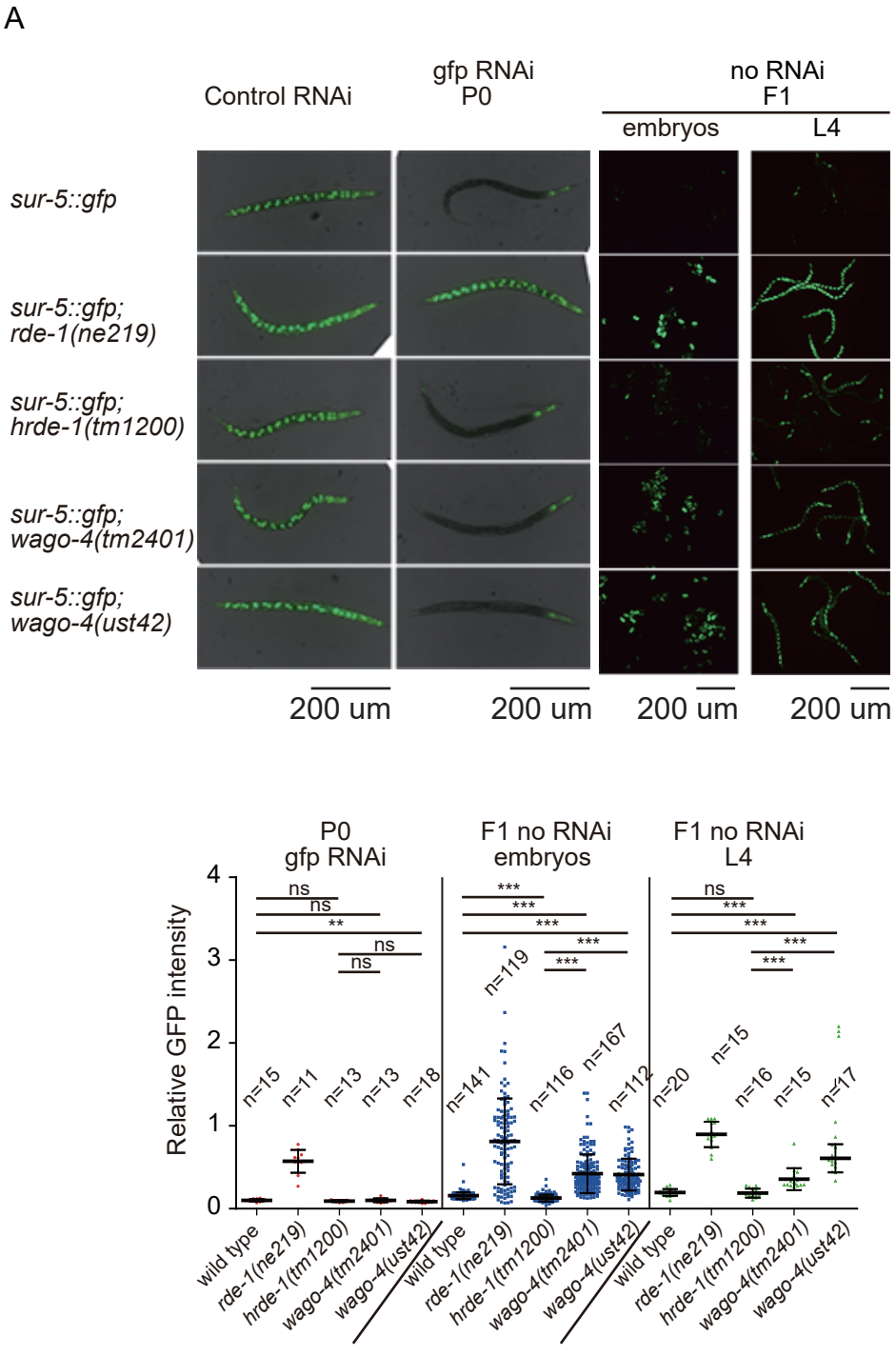

A
Control RNAi
gfp RNAi P0
no RNAi F1
embryos
L4
sur-5::gfp
sur-5::gfp; rde-1(ne219)
sur-5::gfp; hrde-1(tm1200)
sur-5::gfp; wago-4(tm2401)
sur-5::gfp; wago-4(ust42)
200 um
200 um
200 um
200 um
P0 gfp RNAi
F1 no RNAi embryos
F1 no RNAi L4
Relative GFP intensity
0
1
2
3
4
ns
ns
**
ns
ns
***
***
***
***
***
ns
***
***
***
n=15
n=11
n=13
n=13
n=18
n=141
n=119
n=116
n=167
n=112
n=20
n=15
n=16
n=15
n=17
wild type
rde-1(ne219)
hrde-1(tm1200)
wago-4(tm2401)
wago-4(ust42)
wild type
rde-1(ne219)
hrde-1(tm1200)
wago-4(tm2401)
wago-4(ust42)
wild type
rde-1(ne219)
hrde-1(tm1200)
wago-4(tm2401)
wago-4(ust42)
B
control RNAi
P0 gfp RNAi
F1 no RNAi
gfp::h2b
gfp::h2b; hrde-1(tm1200)
gfp::h2b; wago-4(tm1019)
gfp::h2b; wago-4(ust42)
gfp::h2b; ppw-2(tm1120)
gfp::h2b; c04f12.1(tm1637)
gfp::h2b; wago-10(tm1186)
20 um
green
dim
dark
100%
80%
60%
40%
20%
0%
n=52
n=40
n=31
n=28
gfp::h2b
ppw-2(tm1120); gfp::h2b
c04f12.1(tm1637); gfp::h2b
wago-10(tm1186); gfp::h2b

Figure 4

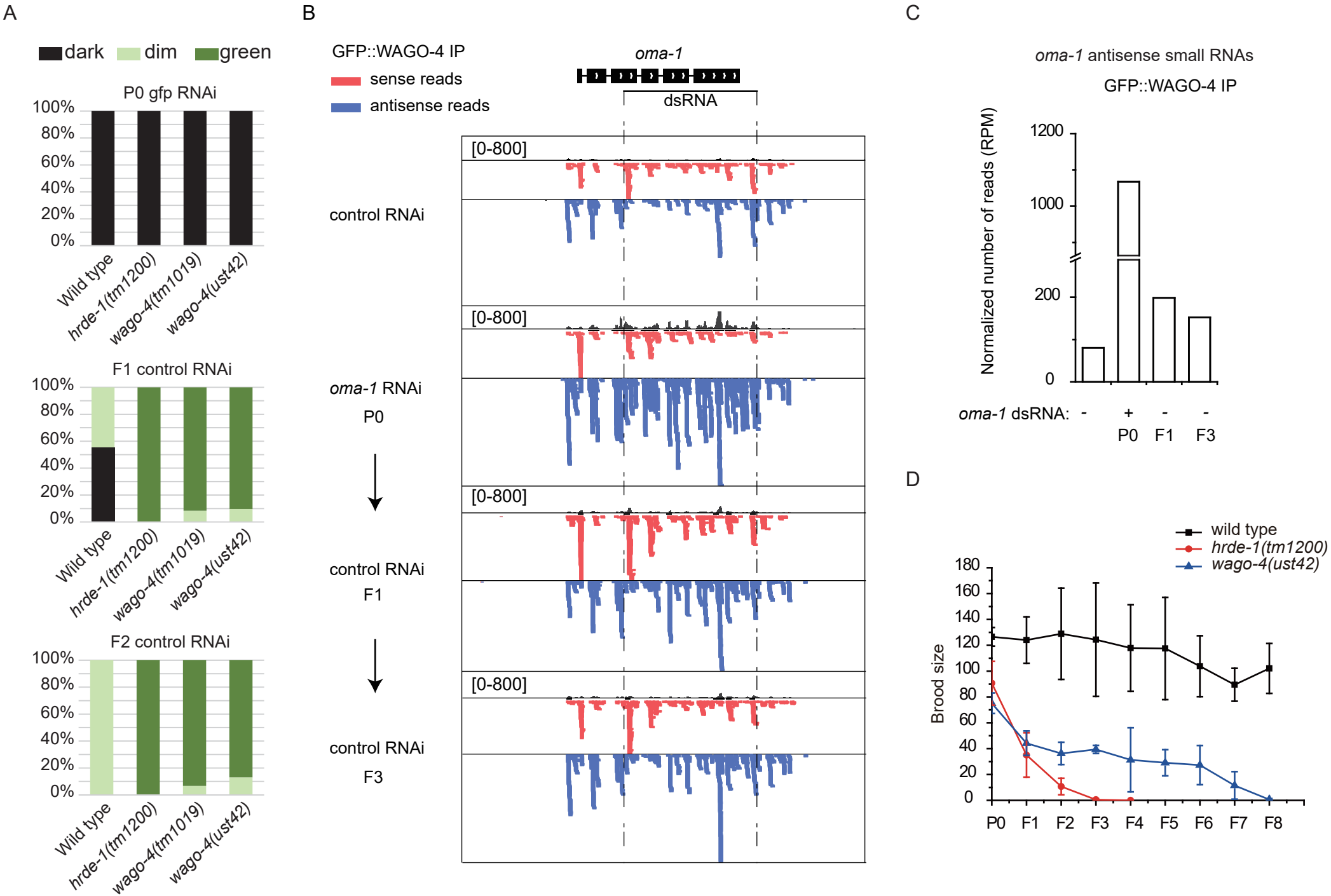

A
dark
dim
green
P0 gfp RNAi
100%
80%
60%
40%
20%
0%
Wild type
hrde-1(tm1200)
wago-4(tm1019)
wago-4(ust42)
F1 control RNAi
F2 control RNAi
B
GFP::WAGO-4 IP
sense reads
antisense reads
oma-1
dsRNA
[0-800]
control RNAi
oma-1 RNAi
P0
control RNAi
F1
control RNAi
F3
C
oma-1 antisense small RNAs
GFP::WAGO-4 IP
Normalized number of reads (RPM)
1200
1000
200
0
oma-1 dsRNA: - + - -
P0 F1 F3
D
wild type
hrde-1(tm1200)
wago-4(ust42)
Brood size
180
160
140
120
100
80
60
40
20
0
P0 F1 F2 F3 F4 F5 F6 F7 F8

Figure 5

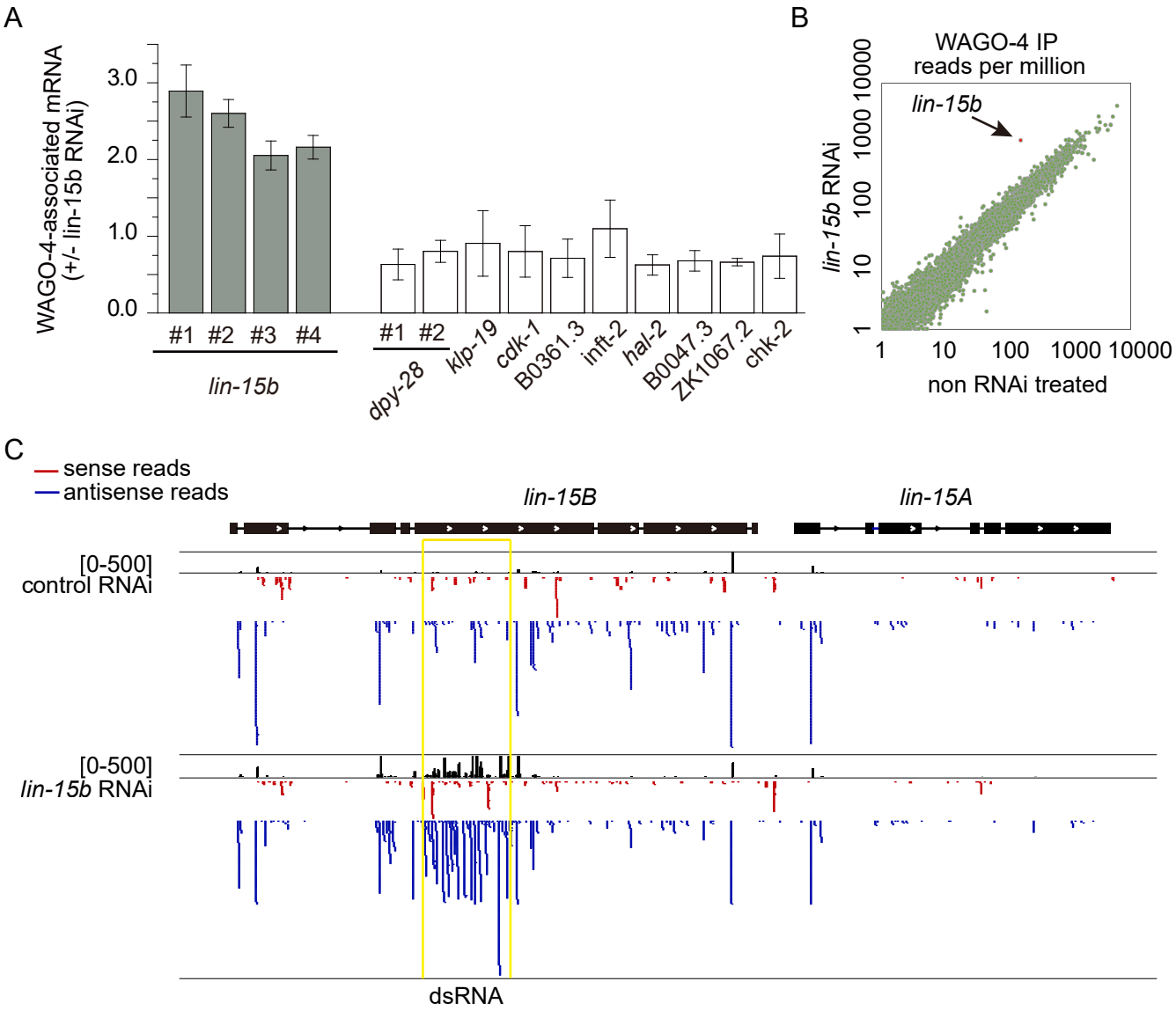


Figure 6

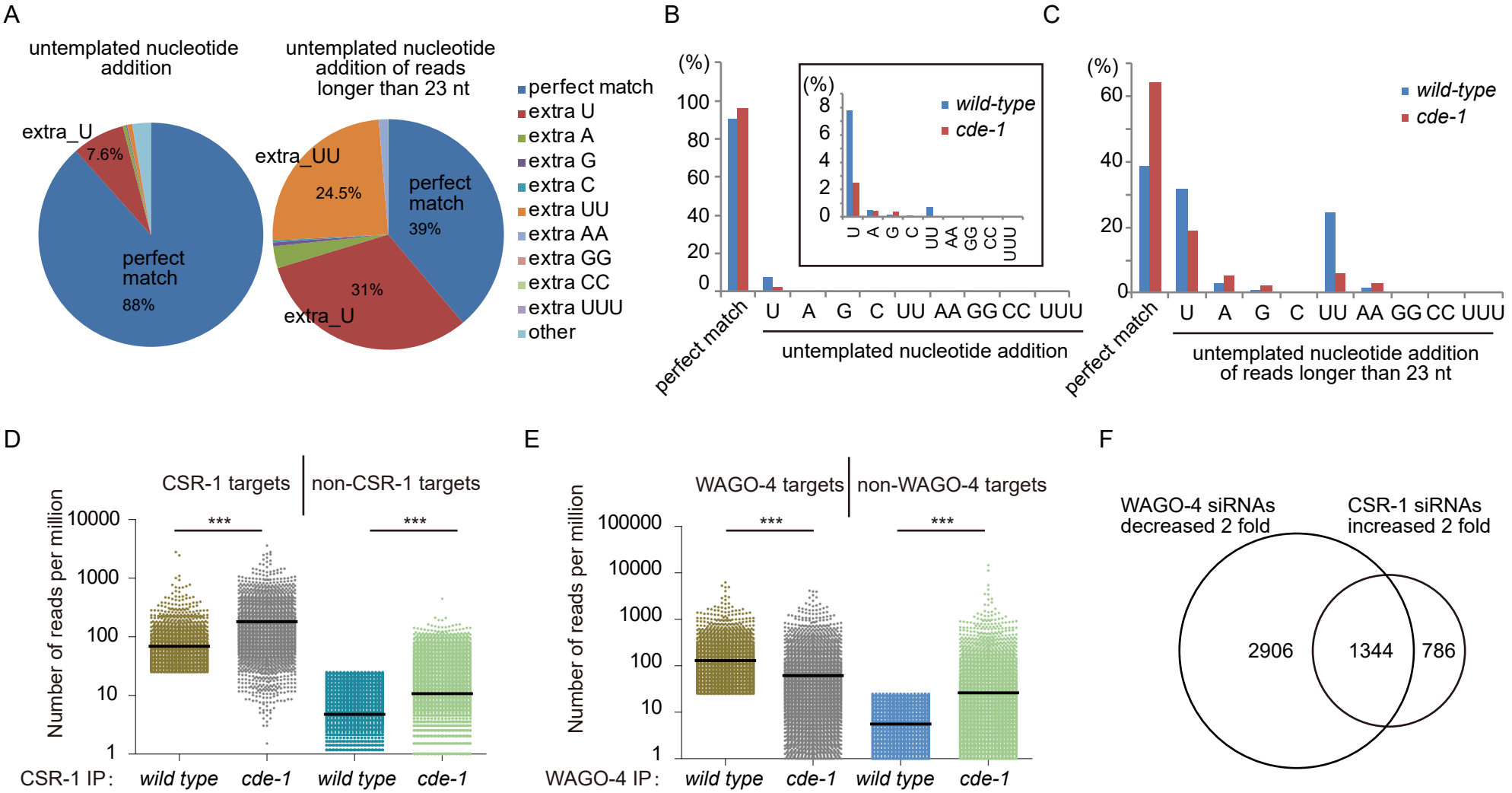
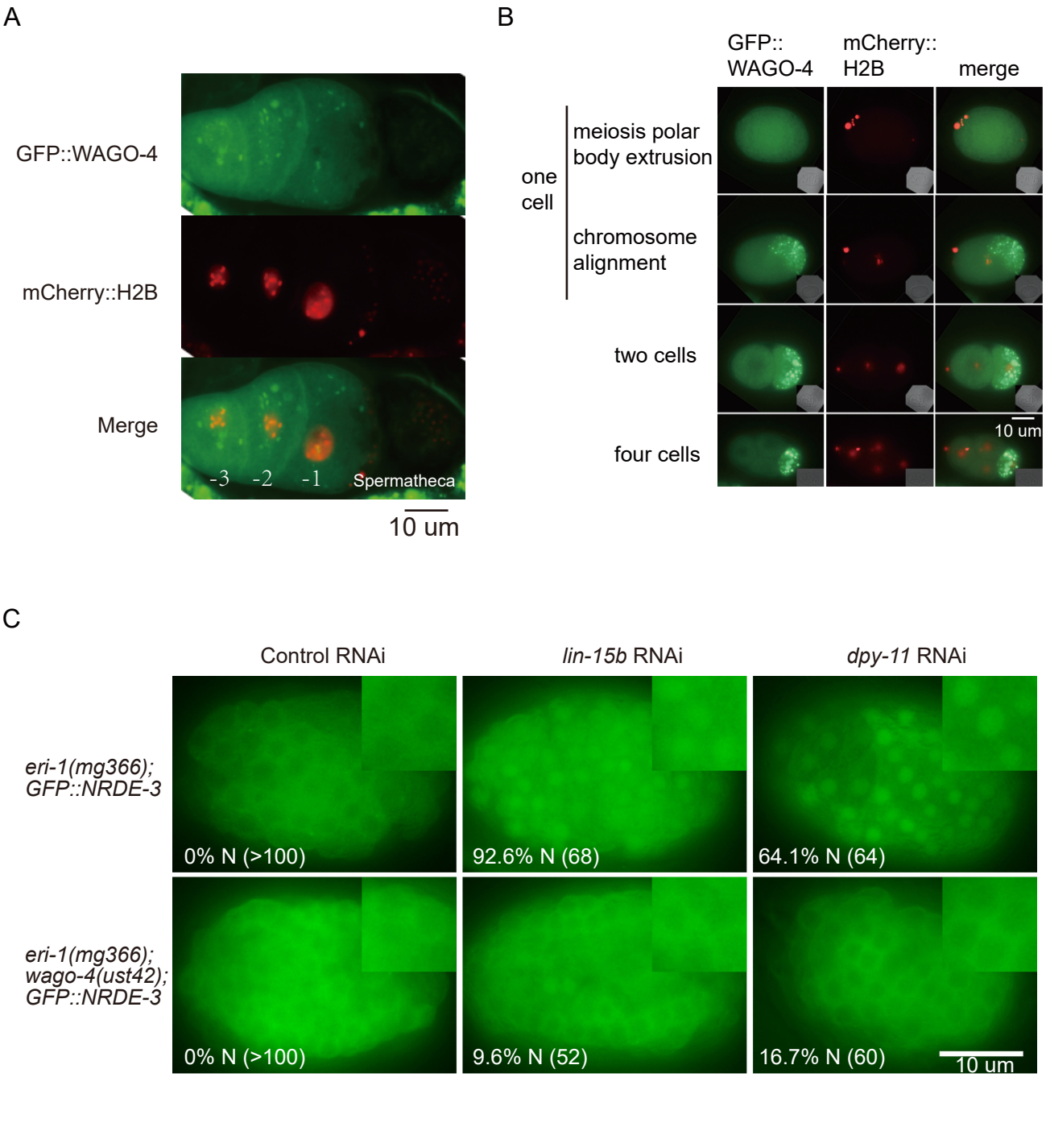

A
untemplated nucleotide addition
untemplated nucleotide addition of reads longer than 23 nt
extra_U
7.6%
perfect match
88%
extra_UU
24.5%
perfect match
39%
31%
extra_U
perfect match
extra U
extra A
extra G
extra C
extra UU
extra AA
extra GG
extra CC
extra UUU
other
B
(%)
wild-type
cde-1
perfect match
U A G C UU AA GG CC UUU
untemplated nucleotide addition
C
(%)
wild-type
cde-1
perfect match
U A G C UU AA GG CC UUU
untemplated nucleotide addition of reads longer than 23 nt
D
CSR-1 targets
non-CSR-1 targets
Number of reads per million
***
***
CSR-1 IP:
wild type
cde-1
wild type
cde-1
E
WAGO-4 targets
non-WAGO-4 targets
Number of reads per million
***
***
WAGO-4 IP:
wild type
cde-1
wild type
cde-1
F
WAGO-4 siRNAs decreased 2 fold
CSR-1 siRNAs increased 2 fold
2906
1344
786

Figure 7



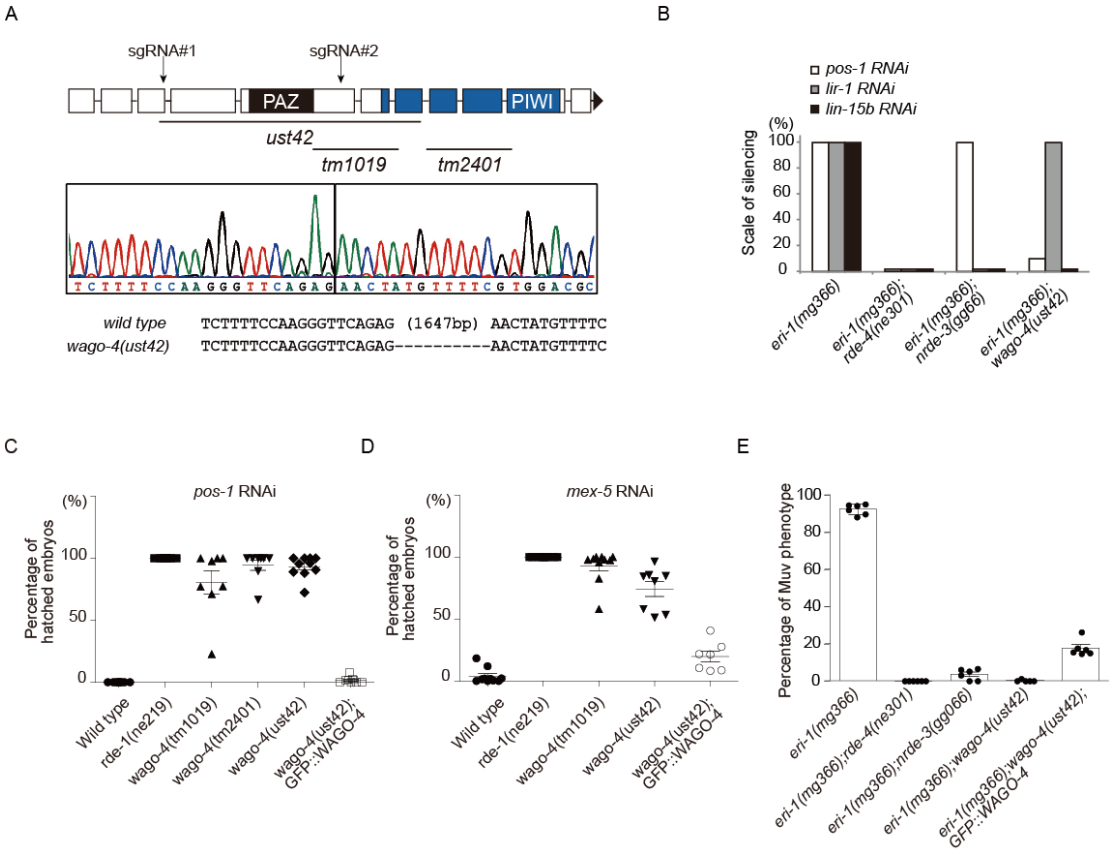


Figure S1. WAGO-4 is involved in RNAi targeting germline-expressed genes, Related to Figure 1.

(a) Schematic of WAGO-4 and the *ust42* allele generated by CRISPR/Cas9 technology. (b) Feeding RNAi analysis of indicated animals. *pos-1* RNAi induces embryonic lethality; *lir-1* RNAi elicits growth arrest at the L2 stage; *lin-15b* RNAi results in the muv phenotype in F1 animals. n>100 animals. (c, d, e) The indicated animals were treated with *pos-1*, *mex-5*, or *lin-15b* dsRNA, and the phenotypes were scored.

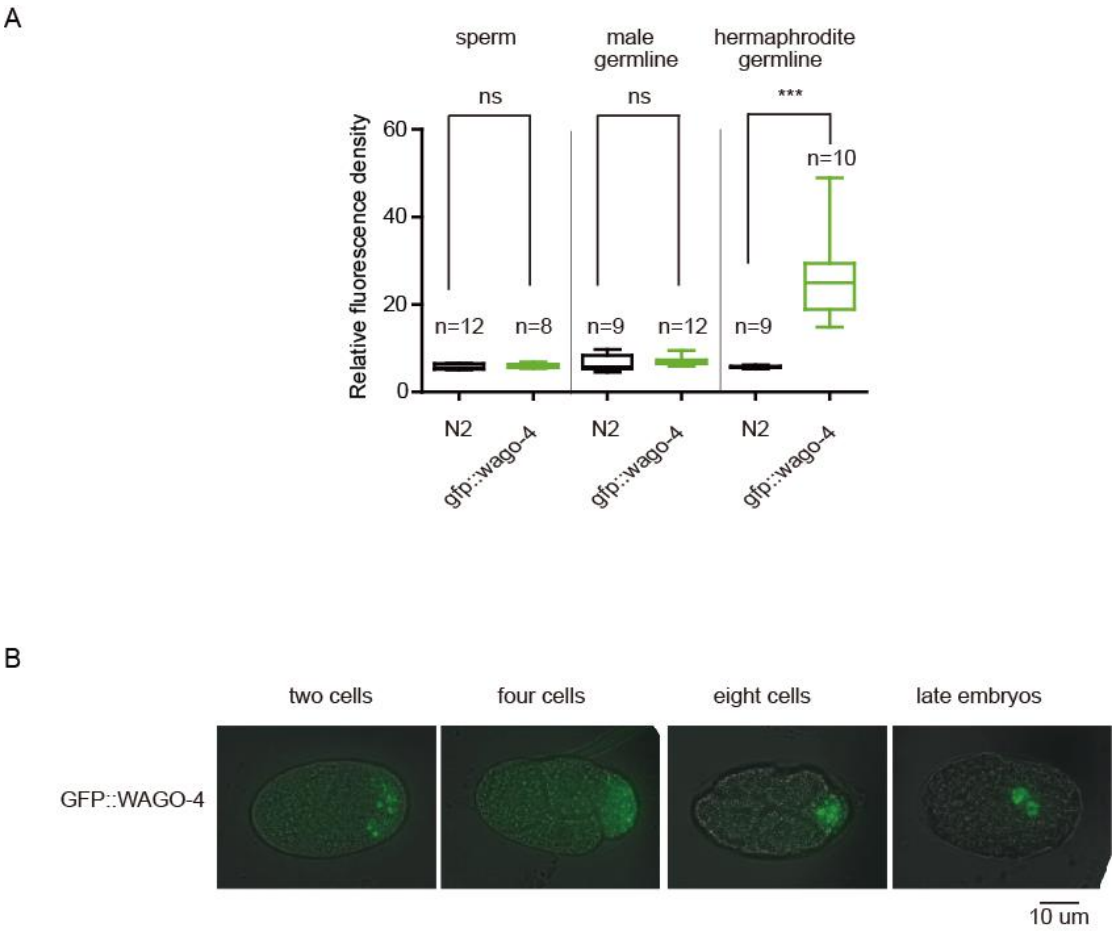


Figure S2. WAGO-4 is a germline-expressed Argonaute protein, Related to Figure 2. (a) Quantification of fluorescence density of *GFP::WAGO-4* animals, measured by ImageJ. n indicates the number of animals quantified. ***p<0.001; ns, not significant. (b) Images of GFP::WAGO-4 at indicated developmental stages.

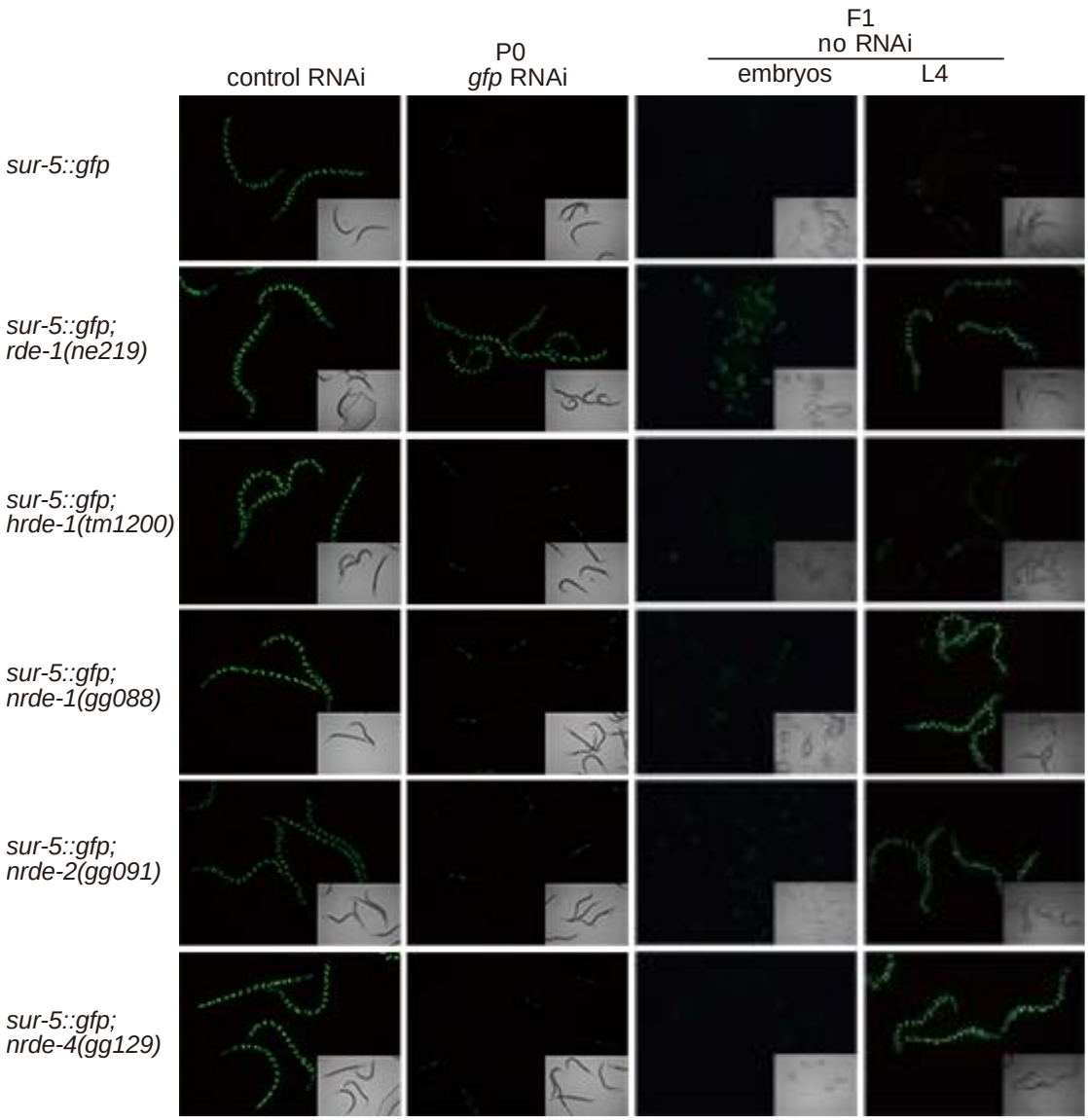
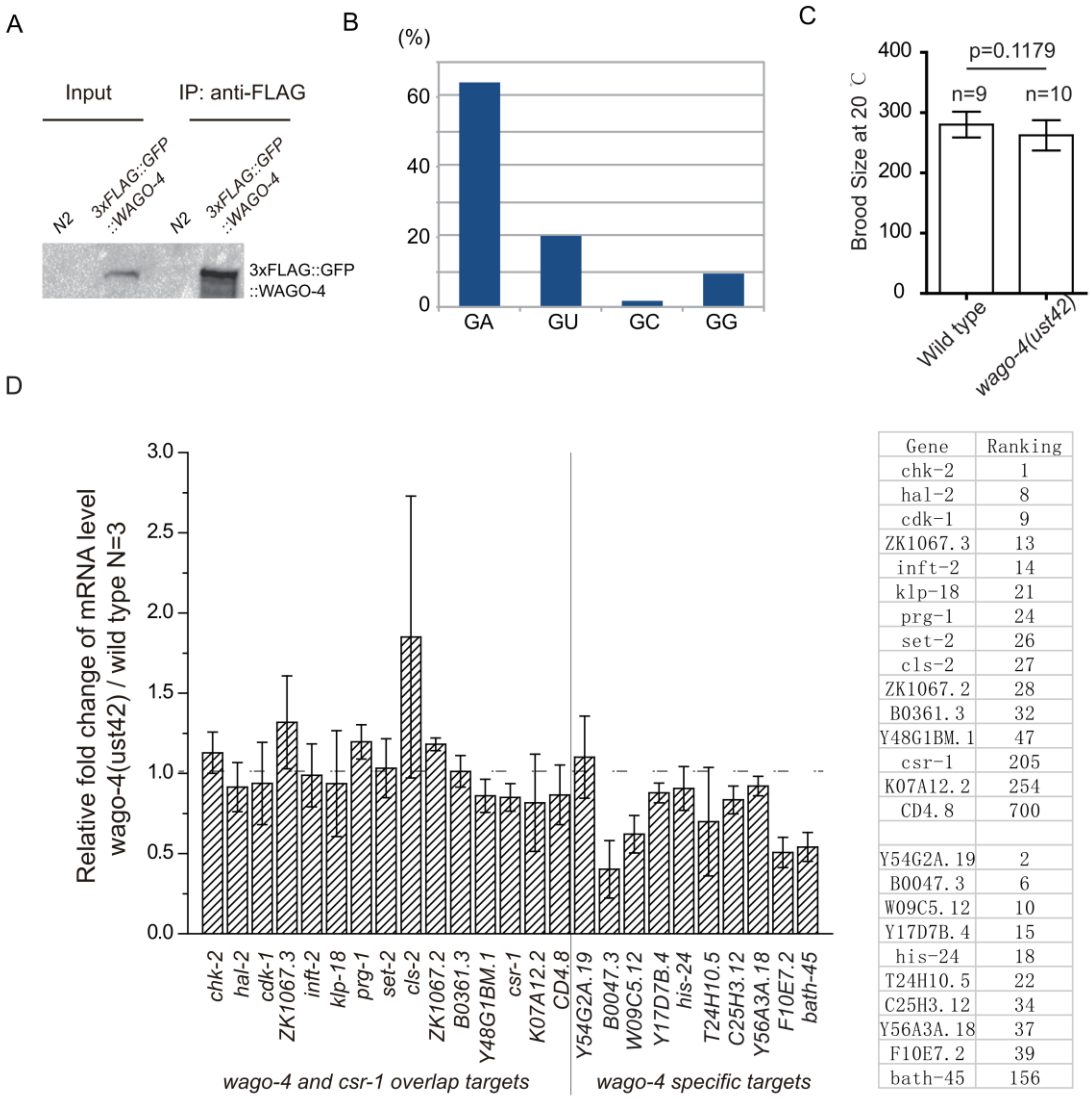


Figure S3. WAGO-4 promotes RNAi inheritance, Related to Figure 3. Images of indicated animals after *gfp* RNAi. F1 embryos were transferred to HT115 control bacteria in the absence of *gfp* dsRNA.



Gene	Ranking
chk-2	1
hal-2	8
cdk-1	9
ZK1067.3	13
inft-2	14
klp-18	21
prg-1	24
set-2	26
cls-2	27
ZK1067.2	28
B0361.3	32
Y48G1BM.1	47
csr-1	205
K07A12.2	254
CD4.8	700
Y54G2A.19	2
B0047.3	6
W09C5.12	10
Y17D7B.4	15
his-24	18
T24H10.5	22
C25H3.12	34
Y56A3A.18	37
F10E7.2	39
bath-45	156

Figure S4. WAGO-4 binds to 22G-RNAs, Related to Figure 5. (a) 3xFLAG::GFP::WAGO-4 was immunoprecipitated from indicated animals and blotted by anti-FLAG antibody. (b) Distribution of the first two nucleotides of WAGO-4 siRNAs. (c) Brood size of indicated animals at 20°C. n indicates the number of animals scored. mean±s.d.. (d) Relative mRNA levels of endogenous WAGO-4 22G-RNA targets in *wago-4(ust42)* animals. Right panel indicates the ranking of WAGO-4 22G-RNA targets. n=3, mean±s.d..

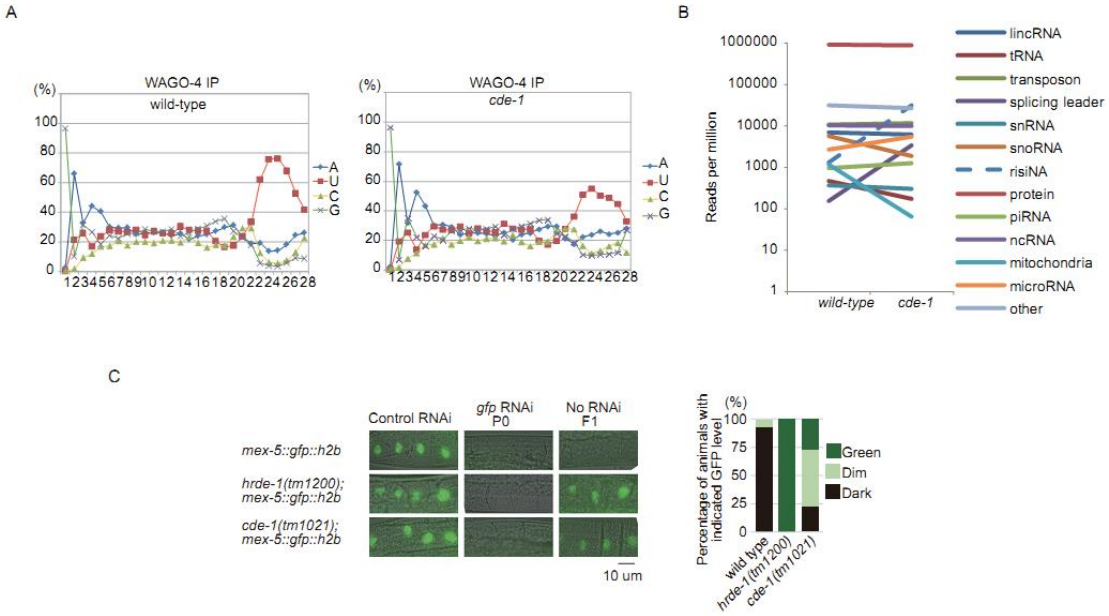


Figure S5. CDE-1 uridylates WAGO-4-associated 22G-RNAs, Related to Figure 6 (a) Nucleotide distribution of WAGO-4-associated 22G-RNAs in wild type animals (left panel) and in *cde-1* mutants (right panel). (b) Small RNA categories of WAGO-4-associated 22G-RNAs in wild type animals and *cde-1* mutants. (c) Images of indicated animals after *gfp* RNAi. F1 animals were grown on HT115 control bacteria. The *gfp* levels were scored in the right panel.

Supplemental Experimental Procedures

Strains used in this study

strains	genotype
	hrde-1(tm1200)
	wago-4(tm1019)
	wago-4(tm2401)
	wago-4(ust42)
	eri-1(mg366)
(YY380)	*eri-1(mg366);rde-4(ne301)*
(YY189)	*eri-1(mg366);nrde-3(gg066)*
(SHG503)	*eri-1(mg366);wago-4(ust42)*
(YY513)	*pkIs32[pie-1p::h2b::gfp]*
(YY528)	*hrde-1(tm1200); pkIs32[pie-1p::h2b::gfp]*
(SHG480)	*wago-4(tm1019); pkIs32[pie-1p::h2b::gfp]*
(SHG481)	*wago-4(ust42); pkIs32[pie-1p::h2b::gfp]*
(SHG482)	*wago-4(tm2401); pkIs32[pie-1p::h2b::gfp]*
(MH1870)	*kuIs54[sur-5:::gfp]*
(YY518)	*nrde-1(gg088);kuIS54[sur-5::gfp]*
(SHG039)	*nrde-2(gg091);kuIS54[sur-5::gfp]*
(YY521)	*nrde-4(gg129); kuIS54[sur-5::gfp]*
(YY548)	*hrde-1(tm1200);kuIs54[sur-5:::gfp]*
(SHG483)	*rde-1(ne219); kuIs54[sur-5:::gfp]*
(SHG485)	*wago-4(ust42); kuIs54[sur-5:::gfp]*
(SHG486)	*wago-4(tm2401);kuIs54[sur-5:::gfp]*
(SHG487)	*ustIs25[wago-4p::3xFLAG::GFP::wago-4]*
(SHG495)	*cde-1(tm1021);ustIS25[wago-4p::3xFLAG::GFP::wago-4]*
(SHG366)	*ustIs45[mex-5p::GFP::his-58::tbb-2utr]*
(SHG501)	*hrde-1(tm1200);mex-5p::GFP::his-58::tbb-2utr*
(SHG502)	*cde-1(tm1021);mex-5p::GFP::his-58::tbb-2utr*
(SHG341)	*ustIs25[wago-4p::3xFLAG::GFP::wago-4];hjSi396[dpy-30p::mRuby::pgl-1]*
(SHG506)	*ustIs25[wago-4p::3xFLAG::GFP::wago-4];ltIs37[(pAA64) pie-1p::mCherry::his-58 + unc-119(+)]*.

Primers used in this study

lin-15b mRNA #1F	TTTCCAGTGGGCTGACACAA
lin-15b mRNA #1R	AACGTGTCGTGCCAAACAAG
lin-15b mRNA #2F	TGAGGATTTGTACGAGCGCA
lin-15b mRNA #2R	ACTGTTGCTGTCTAGCTCGG
lin-15b mRNA #3F	TTTGCAAGGCATCGTGTGAC
lin-15b mRNA #3R	TGAAAAGCTGTGCCTGTCCT
lin-15b mRNA #4F	GAAACGCCAGCGGAATTGAA
lin-15b mRNA #4R	GCTTCCAGAACTTGCTTGCG
dpy-28 mRNA # 1F	GTTGAGCTCACTTTCACGGC
dpy-28 mRNA # 1R	AGCTCCGGAACAAGAAACGA
dpy-28 mRNA # 2F	CACCAAGAACAAAGGCCGC
dpy-28 mRNA # 2R	GAGGAGCTCTGCGTCTTGAG
pos-1 mRNA F	TCCAATGAACCCTCGTGGGA
pos-1 mRNA R	TGCTGGTGATTTGGATGAAG
eft-3 mRNA F	ACTTGATCTACAAGTGCGGAGGA
eft-3 mRNA R	AAAGATCCCTTACCCATCTCCTG
klp-19 RTF	TTGCATTGCAAAAAGAAGTTTCC
klp-19 RTR	TAATACAAACGTTGTTCCTCCAAT
cdk-1 RTF	AAAGTTACACATTCCAAATTCTTC
cdk-1 RTR	TACCAGAGAGTGACAACTTCATGC
B0361.3 RTF	TGAATTCTGTCAATGATTTCTAC
B0361.3 RTR	AATATTTGCACAACGAACCAATATG
inft-2 RTF	CTCCGGGCTCAACTAAGGCTAA
inft-2 RTR	TAGGCTCGGGAGATATCGAATGT
hal-2 RTF	ACATTCCGCCTCTGGTTTCTACA
hal-2 RTR	GTATTTGCATTTCAATCTTATCCAAG
B0047.3 RTF	TTACGTTCTGAAAGTGTATCTGGC
B0047.3 RTR	ATCGATGGTAGAATCATCAATCG
zk1067.2 RTF	TCGAAAAGATGAATCTCGAATG
zk1067.2 RTR	CTTTGCGTTACACGGTTTCG
chk-2 RTF	TTCTTCCATCGACTTGGCAGACG
chk-2 RTR	CGTTTCTGTGTCTCTATCAATGG
oma-1 RTF	CCTAGACGCCGCGGATTAGC
oma-1 RTR	AGCGGCTCGACGAATGTTGG
csr-1 qRTF	ACAGAGTGCCATTAGAAGCGAAAG
csr-1 qRTR	GTACTGAGTCGATTGAGGATCGAG
ego-1 qRTF	ACCATGTATTACCAGATTACAGTTAGG
ego-1 qRTR	CGGAGTGCCGATTTTCCGATTC
GFP RT F	GGAACTACAAGACACGTGCTG
GFP RT R	GTTTGTCTGCCATGATGTATAC
Y54G2A.19 RTF	GACGACCGGACCTGGATCTCAT
Y54G2A.19 RTR	GGCTTTTGCGTCCGGTTGAA
B0047.3 RTF	TCAGCTGGAGAATTTGAAAACCGT

B0047.3 RTR	GCGACGCAAAAAGCACTTCGT
W09C5.12 RTF	GGTCATCCAAACATCACATCACTGG
W09C5.12 RTR	GGCAGCTGGTCCTAAGTTGCT
Y17D7B.4 RTF	ACGTCAGGGGCCCAGAAACT
Y17D7B.4 RTR	TCCGATCCATCGTCGAGTGCT
his-24 RTF	AAGCAGCTCAAGGACCGCAA
his-24 RTR	GACGGAGATGAGCATTGATCTGG
T24H10.5 RTF	TGCAGCAAAACGAATCGTGGG
T24H10.5 RTR	TAAGTTGCTCCGGTCCAGACAC
C25H3.12 RTF	CCGAATATGGCAAGGATTTCCGC
C25H3.12 RTR	AACGCCCGCACCTTCGTTTA
Y56A3A.18 RTF	CAAGCTTCTCCAGCAAGAGATCG
Y56A3A.18 RTR	TGCGATGAAGCTGTCGGGTT
F10E7.2 RTF	GTCCGCACATTGCAACAACG
F10E7.2 RTR	TTGGTCGCAAGCCGCTTTAT
zk1067.3 RTF	CGAAGAAGGCTGATAGAAAAAAGATCAATC
zk1067.3 RTR	GCAAAGTGTCGATAGAACTGTTTGAA
klp-18 RTF	GTTGCATTGCAAAAAGAAGTTTCC
klp-18 RTR	CGTAATACAAACGTTGTTCCTCCAA
prg-1 RTF	GGAAGGTGAACATTCCGCTTAAAAAC
prg-1 RTR	GTAATACTGCTTCAAGGCTTTTCGAACA
set-2 RTF	GATAAATCAGCTCAAATTCCGCAA
set-2 RTR	ACCAGAGATCGGATCGTCTGTC
cls-2 RTF	GCTCATTTTGAATGAGGAGAAAG
cls-2 RTR	ATGGGGAATCGTAAGACTTGATCA
Y48G1BM.1 RTF	TGGATCCGTCGATCACAATC
Y48G1BM.1 RTR	GTGGGATTCATCTCTCAGGC
csr-1 RTF	CAGAGTGCCATTAGAAGCGAAAGA
csr-1 RTR	GTACTGAGTCGATTGAGGATCGAG
K07A12.2 RTF	ACAATGCTCTTTATGCACTCCCGT
K07A12.2 RTR	TGGACAATGTTGTTGTTCTGAACA
CD4.8 RTF	TGCCTACCACAGGAGATTTCAAAG
CD4.8 RTR	TGCCAGTCGATTTGATCAATGTCA
bath-45 RTF	CTATGCTATTGACGACGACAACG
bath-45 RTR	TGAGAGACAGTGCTTCTTCAAGT

Table S1. WAGO-4-associated siRNAs targeted genes, Related to Figure 5

The targets were selected using a threshold of 25 reads per million total reads.

Gene ID	#number of reads	#number of reads per million
Y60A3A.12	68454	5814.489796
Y54G2A.19	58383	4959.058021
Y46G5A.4	54191	4602.98911
F32D1.1	53772	4567.399207
F07A5.1	48419	4112.714837
B0047.3	44266	3759.95859
Y106G6H.2	36218	3076.360643
T16H12.11	35436	3009.937482
T05G5.3	34791	2955.151116
W09C5.12	34590	2938.078155
F15D3.7	33119	2813.131264
F10G7.4	31380	2665.420425
ZK1067.3	28921	2456.552713
F15B9.4	24131	2049.68962
Y17D7B.4	23587	2003.482204
K11D9.1	21395	1817.293499
M01E11.6	20888	1774.228867
M163.3	20459	1737.789563
C47G2.8	20128	1709.674389
K11D12.2	19971	1696.338793
C06G3.2	19702	1673.489905
T24H10.5	18994	1613.352312
F46F11.9	18595	1579.461211
D2030.6	18445	1566.720196
Y46G5A.5	17970	1526.373647
C26E6.9	17899	1520.3429
R107.6	17828	1514.312152
ZK1067.2	17807	1512.52841
D2096.2	17675	1501.316317
F58G1.1	17044	1447.719112
K09H11.3	16949	1439.649802
B0361.3	16778	1425.125045
F58A4.10	16572	1407.627383
C25H3.12	16109	1368.300116
B0273.3	15774	1339.845181
ZK430.1	15634	1327.953567
Y56A3A.18	15386	1306.888421
T05H10.7	15276	1297.54501
F10E7.2	14846	1261.020766
B0250.8	14511	1232.565832
C36A4.5	14508	1232.311011
Y45G5AM.2	14428	1225.515803
R06F6.1	14411	1224.071821
D2045.2	14220	1207.848262

F36A4.7	14056	1193.918085
T01G9.2	13986	1187.972278
Y48G1BM.1	13763	1169.030635
Y55F3AM.10	13730	1166.227611
K12D12.5	13689	1162.745067
Y48B6A.3	13470	1144.143185
C14C11.6	13106	1113.224987
F36D4.3	13025	1106.344839
F15E6.1	12862	1092.499602
Y73B6A.5	12859	1092.244782
T01C3.8	12386	1052.068113
Y24D9A.1	12244	1040.006619
Y48G1BL.2	12172	1033.890931
B0432.2	12026	1021.489676
F11A10.1	11930	1013.335426
ZK381.4	11758	998.7257286
T12E12.3	11717	995.2431844
F26D10.3	11648	989.3823173
Y46H3C.6	11627	987.5985751
T05H10.1	11599	985.2202522
F09E5.10	11569	982.6720492
D2096.1	11560	981.9075882
C01G10.11	11427	970.6105546
Y75B8A.19	11422	970.185854
T12F5.3	11373	966.023789
ZK1248.14	11107	943.4297217
B0414.5	11066	939.9471774
Y37A1C.1	11020	936.0399327
Y34D9A.4	11012	935.3604119
ZC317.1	10945	929.669425
W02G9.5	10895	925.4224199
Y43F4B.6	10890	924.9977194
F37D6.3	10812	918.3723913
Y67D8C.5	10775	915.2296075
T05H10.5	10728	911.2374227
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Y71A12B.10	10499	891.7861392
T05H4.1	10498	891.7011991
Y53F4B.9	10423	885.3306914
C26E6.3	10395	882.9523685
ZK328.2	10373	881.0836862
F34D10.4	10328	877.2613816
F25D7.4	10279	873.0993166
Y39G10AR.7	10257	871.2306343
F29B9.2	10131	860.5281813
F36H1.2	10113	858.9992595
R07H5.1	10057	854.2426137

T20D3.11	9929	843.3702806
Y111B2A.3	9909	841.6714785
Y53C10A.12	9855	837.084713
Y37E3.15	9750	828.1660022
C56C10.3	9717	825.3629788
T09A5.11	9604	815.7647472
Y51H4A.12	9552	811.3478618
F10F2.1	9470	804.3827734
T01E8.5	9402	798.6068464
C03H5.2	9400	798.4369662
Y60A3A.13	9218	782.9778675
F59E12.6	9172	779.0706228
Y49E10.19	9011	765.3952662
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C47B2.3	8978	762.5922428
T08B2.9	8888	754.9476336
F53F10.2	8855	752.1446102
Y57G11C.51	8840	750.8705086
Y54G11A.14	8809	748.2373655
F22H10.4	8793	746.8783238
Y48A5A.1	8793	746.8783238
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T03F6.5	8776	745.4343421
T05E7.3	8773	745.1795218
F13H10.8	8719	740.5927562
F20C5.3	8662	735.7511703
F55F10.1	8616	731.8439256
Y110A7A.18	8610	731.334285
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F13D12.5	8548	726.0679986
F48E8.6	8484	720.6318321
T12E12.2	8473	719.6974909
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F59E12.10	8396	713.157103
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T12G3.1	8315	706.2769547
T19B4.7	8151	692.3467778
T10G3.5	8131	690.6479758
C38D4.9	8073	685.7214498
C14B1.7	8068	685.2967493
F28H1.3	8021	681.3045645
C53D5.6	7987	678.416601
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T21E12.4	7792	661.8532809
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C10C5.1	7703	654.2936118
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F37A4.9	7614	646.7339426
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K08E7.3	7224	613.6073025
Y52B11A.18	7179	609.7849979
Y18D10A.25	7131	605.707873
Y44E3A.6	7125	605.1982324
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F22B5.7	7077	601.1211074
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C27A2.2	6976	592.542157
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K12H4.8	6920	587.7855113
R12C12.2	6905	586.5114097
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B0205.9	6772	575.2143761
Y71G12B.8	6755	573.7703943
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F28F8.5	6669	566.4655455

C38D4.3	6647	564.5968632
F26G5.9	6633	563.4077018
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T12D8.1	6621	562.3884206
F37A4.8	6583	559.1606967
C01H6.5	6569	557.9715352
C18G1.4	6558	557.0371941
F57B9.5	6551	556.4426134
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Y73B6BL.5	6526	554.3191108
Y110A7A.1	6523	554.0642905
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T20G5.11	6458	548.5431838
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Y43F11A.5	6356	539.8792933
K10D2.3	6333	537.925671
R05D11.8	6325	537.2461501
Y40B10A.8	6280	533.4238455
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F10G7.3	6204	526.9683977
Y39G10AR.18	6187	525.5244159
Y92H12BR.3	6154	522.7213926
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C18A3.5	6137	521.2774108
Y49E10.17	6124	520.1731895
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F55A3.3	5993	509.046036
F56A3.4	5976	507.6020543
C17E4.3	5969	507.0074735
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C32B5.6	5958	506.0731324
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Y75B8A.13	5950	505.3936116
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Y71A12B.17	5935	504.11951
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Y71F9AL.9	5825	494.7760987
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C47D12.1	5811	493.5869373
F58G11.3	5811	493.5869373
K08E5.1	5810	493.5019972
C15H11.5	5803	492.9074165
T19B10.11	5795	492.2278957
F48C1.6	5787	491.5483748
T26A5.5	5764	489.5947525
C26H9A.1	5758	489.0851119
C03C10.1	5756	488.9152316
Y92H12A.5	5751	488.4905311
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Y113G7B.17	5709	484.9230468
F25H5.5	5700	484.1585859
K07A12.2	5685	482.8844843
Y73B6BL.23	5675	482.0350833
Y92H12BR.2	5662	480.930862
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Y67D8C.6	5595	475.2398751
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T09A5.10	5579	473.8808335
F17A9.2	5567	472.8615522
R05F9.11	5548	471.2476903
T28A8.6	5539	470.4832293
Y41E3.11	5527	469.4639481
Y48G1BM.6	5503	467.4253856
C07A9.7	5502	467.3404455
ZK328.1	5495	466.7458648
R07H5.8	5493	466.5759846
C50C3.6	5470	464.6223622
F58B6.3	5457	463.5181409
F59A2.1	5441	462.1590993
F41H10.10	5438	461.904279
T22D1.9	5436	461.7343988
K04D7.1	5420	460.3753571
F55H2.6	5416	460.0355967
Y38F2AR.7	5411	459.6108962
T23H2.1	5409	459.441016
C47D12.2	5406	459.1861957
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K08E3.3	5382	457.1476332
T08D2.7	5370	456.128352
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Y65B4BR.4	5345	454.0048494
T21G5.3	5335	453.1554484
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Y92H12A.4	5288	449.1632635
W05F2.5	5274	447.9741021
F01G4.6	5262	446.9548209
C28C12.2	5250	445.9355396
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C24G6.8	5225	443.8120371
D1054.15	5194	441.1788939
F56A3.3	5186	440.4993731
F10G7.1	5185	440.414433
ZK177.6	5174	439.4800918
C35D10.7	5160	438.2909304
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C10C5.6	5156	437.95117
R05D11.3	5136	436.2523679
Y73B3A.1	5131	435.8276674
F01G4.4	5109	433.9589851
F32D1.10	5109	433.9589851
F33A8.4	5097	432.9397039
F59C12.4	5091	432.4300633
Y102A5A.1	5086	432.0053628
Y32F6A.3	5086	432.0053628
F37H8.2	5084	431.8354826
Y77E11A.3	5084	431.8354826
C34D4.14	5047	428.6926988
F01G10.1	5041	428.1830582
Y55F3AR.3	5033	427.5035373
T24C4.7	5030	427.248717
ZK270.2	5020	426.399316
DY3.2	5016	426.0595556
W09C5.2	5004	425.0402743
K10C3.4	4996	424.3607535
R05D3.2	4987	423.5962926
C44E4.3	4971	422.237251
T23G5.2	4965	421.7276103
F53C11.5	4958	421.1330296
F01F1.6	4948	420.2836286
F33G12.4	4946	420.1137484
T23D8.9	4940	419.6041078
C45G3.1	4936	419.2643474
ZC404.8	4924	418.2450661
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ZK328.5	4890	415.3571026
B0432.13	4876	414.1679412

C16A3.1	4874	413.998061
F43E2.1	4862	412.9787798
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K11H3.1	4835	410.685397
F53A3.4	4827	410.0058762
D1081.7	4823	409.6661157
F58D5.1	4818	409.2414152
C38C10.5	4816	409.071535
C36A4.11	4802	407.8823736
Y66H1B.2	4801	407.7974335
Y87G2A.17	4801	407.7974335
F57C2.5	4799	407.6275533
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F59H6.14	4790	406.8630924
C10H11.10	4785	406.4383918
C04F12.9	4780	406.0136913
K01G5.2	4773	405.4191106
Y34D9A.3	4772	405.3341705
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C10H11.9	4764	404.6546497
B0207.4	4763	404.5697096
Y48G9A.3	4752	403.6353684
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C05C8.4	4746	403.1257278
D2005.4	4737	402.3612669
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Y82E9BR.18	4734	402.1064466
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F15B10.1	4721	401.0022253
F38H4.7	4721	401.0022253
F56D2.6	4703	399.4733034
K10C8.1	4693	398.6239024
Y73B6BL.38	4685	397.9443816
F58E10.3	4675	397.0949805
R10E4.9	4669	396.5853399
Y119D3B.16	4651	395.0564181
T09F5.12	4623	392.6780952
T02G5.13	4616	392.0835145
ZK1290.4	4616	392.0835145
F54F2.2	4609	391.4889337
E01A2.2	4605	391.1491733
T19H12.2	4605	391.1491733
T27E9.1	4602	390.894353
Y65B4BL.2	4591	389.9600119
R05G6.7	4576	388.6859104
T14G10.2	4555	386.9021682

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C34H4.5	4548	386.3075875
T23G5.6	4536	385.2883062
Y61A9LA.8	4535	385.2033661
F09E8.3	4526	384.4389052
C43E11.4	4520	383.9292646
F32E10.2	4520	383.9292646
B0414.7	4518	383.7593844
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T01G9.4	4444	377.4738168
R11A8.1	4443	377.3888767
C06A8.5	4441	377.2189965
M18.7	4436	376.794296
R06A4.8	4424	375.7750147
K08A2.5	4414	374.9256137
Y62E10A.20	4413	374.8406736
Y110A7A.17	4405	374.1611528
C26C6.5	4395	373.3117518
ZK896.9	4395	373.3117518
Y49E10.20	4390	372.8870512
C04H5.6	4376	371.6978898
R07B7.2	4372	371.3581294
Y71A12B.9	4364	370.6786086
F16A11.3	4359	370.2539081
D2096.8	4351	369.5743872
F53G12.1	4346	369.1496867
F28D1.10	4342	368.8099263
T06E4.3	4339	368.555106
K07C5.6	4329	367.705705
Y39G10AR.21	4326	367.4508847
Y48G1A.5	4318	366.7713638
C13B4.1	4315	366.5165435
M01G5.5	4313	366.3466633
R07B7.1	4312	366.2617232
E04D5.1	4303	365.4972623
W06H3.2	4303	365.4972623
F10B5.8	4296	364.9026816
C18E3.6	4291	364.4779811
F31C3.2	4288	364.2231608
C26D10.1	4277	363.2888196
C44E4.1	4260	361.8448379
C33H5.11	4244	360.4857962
T19A5.2	4232	359.466515
Y102E9.2	4223	358.7020541
C12D8.11	4200	356.7484317
C46F11.5	4196	356.4086713
T18H9.7	4188	355.7291505

F10E7.8	4185	355.4743302
F20G4.3	4173	354.4550489
T03F1.9	4173	354.4550489
R11A8.6	4171	354.2851687
F40F11.2	4170	354.2002286
Y14H12B.2	4170	354.2002286
Y39A3CL.1	4158	353.1809474
F55F8.9	4154	352.841187
T05F1.1	4153	352.7562469
T22F3.3	4134	351.1423849
Y57A10A.4	4132	350.9725047
R05D3.7	4126	350.4628641
C14A4.5	4125	350.377924
Y59E9AL.36	4112	349.2737027
Y43H11AL.3	4100	348.2544214
T05E11.6	4091	347.4899605
W02D3.1	4090	347.4050204
F44B9.3	4077	346.3007991
C27B7.4	4069	345.6212782
B0365.3	4068	345.5363381
Y18D10A.9	4061	344.9417574
F56C9.3	4060	344.8568173
B0464.5	4059	344.7718772
F38E11.5	4048	343.8375361
T24H7.1	4046	343.6676559
B0047.1	4029	342.2236741
JC8.6	4029	342.2236741
F36F2.3	4006	340.2700518
Y2H9A.1	3993	339.1658304
Y37H9A.2	3989	338.82607
F58A4.3	3988	338.7411299
M7.2	3976	337.7218487
Y57G11C.499	3961	336.4477471
F26A3.3	3947	335.2585857
R11A8.7	3940	334.664005
C26B2.1	3928	333.6447238
F32E10.4	3913	332.3706222
F25D1.1	3910	332.1158019
T13F2.3	3904	331.6061613
Y59A8A.2	3897	331.0115806
K07C5.3	3889	330.3320597
F54E12.2	3886	330.0772394
T23B12.2	3869	328.6332577
W02B12.9	3869	328.6332577
F55G1.8	3864	328.2085572
C25D7.6	3862	328.038677
F20H11.2	3851	327.1043358
F21H12.5	3847	326.7645754

Y110A7A.21	3837	325.9151744
C38D4.5	3835	325.7452942
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F46F3.4	3821	324.5561328
Y6D1A.1	3821	324.5561328
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F12F6.6	3787	321.6681693
B0250.7	3785	321.4982891
Y54E2A.12	3785	321.4982891
Y55D5A.5	3784	321.4133489
K05C4.2	3771	320.3091276
F35G12.8	3767	319.9693672
C52E12.4	3765	319.799487
T27C4.4	3764	319.7145469
K02F2.4	3759	319.2898464
T25G3.2	3755	318.950086
Y57G11C.43	3748	318.3555052
C47E8.8	3743	317.9308047
Y18D10A.17	3740	317.6759844
Y113G7A.3	3733	317.0814037
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T28A8.7	3730	316.8265834
Y71G12B.13	3730	316.8265834
C23G10.4	3723	316.2320027
Y71G12A.2	3722	316.1470626
C25A1.1	3715	315.5524819
C56G2.7	3715	315.5524819
T07G12.12	3711	315.2127214
F28F8.9	3707	314.872961
Y73E7A.2	3692	313.5988595
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F46B6.4	3685	313.0042788
ZK1236.6	3684	312.9193387
F26E4.8	3682	312.7494585
W03G1.6	3681	312.6645184
Y95B8A.5	3681	312.6645184
F26H11.2	3680	312.5795783
ZK856.12	3678	312.4096981
C28A5.2	3677	312.324758
F55A3.6	3663	311.1355965
ZK370.3	3648	309.861495
C38D4.4	3645	309.6066747
T10B11.7	3642	309.3518544
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T24B8.7	3637	308.9271538
F52B5.3	3633	308.5873934
LLC1.3	3633	308.5873934

F53H1.4	3631	308.4175132
Y39G10AR.13	3628	308.1626929
Y54E5B.1	3622	307.6530523
F28D9.4	3613	306.8885914
Y57A10A.1	3613	306.8885914
ZK593.5	3613	306.8885914
F33A8.1	3606	306.2940107
C13F10.4	3605	306.2090705
B0336.1	3601	305.8693101
C07E3.2	3601	305.8693101
M18.5	3591	305.0199091
C48B4.4	3590	304.934969
C02F4.1	3583	304.3403883
T26C5.3	3574	303.5759274
F26A3.8	3572	303.4060472
W02A11.1	3566	302.8964065
C17H12.2	3559	302.3018258
Y37E3.1	3559	302.3018258
K07C5.4	3558	302.2168857
Y47G6A.12	3552	301.7072451
W08F4.3	3548	301.3674847
C03D6.4	3539	300.6030238
C16A3.10	3538	300.5180837
R12E2.10	3536	300.3482035
F15D4.5	3531	299.9235029
H12I13.4	3529	299.7536227
C28A5.1	3526	299.4988024
M01G5.1	3520	298.9891618
C04G2.10	3511	298.2247009
Y71G10AL.1	3511	298.2247009
Y67H2A.7	3508	297.9698806
C05D2.5	3506	297.8000004
C37A2.4	3505	297.7150603
Y20F4.4	3505	297.7150603
Y71F9B.7	3505	297.7150603
Y105E8A.28	3503	297.5451801
W01B11.3	3498	297.1204796
C54G10.3	3491	296.5258988
F18A1.3	3490	296.4409587
F33H2.5	3489	296.3560186
W09D10.1	3489	296.3560186
T27E9.4	3481	295.6764978
B0001.3	3468	294.5722765
B0334.5	3468	294.5722765
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K07C5.8	3464	294.2325161
ZK856.13	3460	293.8927556
F54F2.7	3458	293.7228754

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T07E3.3	3452	293.2132348
C38C10.4	3450	293.0433546
F57B9.6	3450	293.0433546
F25B5.2	3440	292.1939536
ZK973.1	3437	291.9391333
C43E11.3	3433	291.5993729
C18G1.5	3416	290.1553911
F22B3.4	3408	289.4758703
M110.4	3406	289.3059901
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Y38H8A.12	3397	288.5415292
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Y77E11A.13	3394	288.2867089
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F09G2.2	3391	288.0318886
Y38C9A.1	3389	287.8620083
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T07A9.9	3384	287.4373078
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F09G2.4	3375	286.6728469
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F52A8.6	3359	285.3138053
Y53C12A.10	3355	284.9740449
Y39E4B.3	3344	284.0397037
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Y42H9B.2	3327	282.595722
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W02B8.2	3325	282.4258418
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Y111B2A.18	3297	280.0475189
F26G1.1	3294	279.7926986
Y41D4B.13	3294	279.7926986
T06E4.1	3290	279.4529382
K07D4.3	3288	279.283058

T26A8.4	3288	279.283058
K07F5.15	3287	279.1981179
Y37E11B.2	3286	279.1131778
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F25H5.4	3281	278.6884772
W09B6.1	3278	278.4336569
B0280.10	3273	278.0089564
B0001.5	3270	277.7541361
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C17G10.9	3253	276.3101544
F21D5.6	3248	275.8854539
F55A3.7	3247	275.8005138
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Y17G7B.5	3237	274.9511127
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F26F12.7	3226	274.0167716
R06F6.2	3226	274.0167716
C01H6.9	3224	273.8468914
T12A2.7	3224	273.8468914
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Y37E11B.4	3192	271.1288081
Y73B6BL.6	3191	271.043868
Y71H2B.6	3189	270.8739878
Y48A6B.11	3188	270.7890477
F19F10.12	3186	270.6191675
Y37D8A.12	3183	270.3643472
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F53G12.10	3146	267.2215634

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F28B12.3	3058	259.7468343
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F57C9.4	3042	258.3877927
C16A3.7	3038	258.0480323
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Y53C12B.1	3038	258.0480323
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F42A9.1	3032	257.5383917
Y116A8C.9	3025	256.9438109
C37H5.8	3024	256.8588708
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F40F9.6	2997	254.5654881
F55C5.8	2997	254.5654881
ZK507.6	2995	254.3956078
F01G4.1	2994	254.3106677
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K08D12.1	2980	253.1215063
Y39A1B.3	2980	253.1215063
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VW02B12L.3	2978	252.9516261
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Y37E11AL.8	2953	250.8281235
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ZC308.1	2937	249.4690819
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F20G4.1	2920	248.0251001
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F49E11.1	2903	246.5811184
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F19F10.11	2902	246.4961783
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T23D8.7	2890	245.4768971
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F55A12.8	2877	244.3726757
Y57G11C.10	2876	244.2877356
Y39E4B.2	2873	244.0329153
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Y43F4B.3	2834	240.7202513
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Y18D10A.1	2755	234.0099832
Y61A9LA.3	2750	233.5852827
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Y49E10.11	2749	233.5003426
K10D2.1	2747	233.3304624
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F26F4.6	2731	231.9714207
Y116F11B.12	2727	231.6316603
Y41D4B.19	2727	231.6316603
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E01B7.1	2710	230.1876786
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C42D4.8	2703	229.5930978
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F36A2.13	2698	229.1683973
F44E7.4	2698	229.1683973
T06D8.8	2698	229.1683973
F53H10.2	2697	229.0834572
F52G2.1	2693	228.7436968
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F46F11.2	2689	228.4039364
F57B10.6	2687	228.2340562
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K07G5.2	2682	227.8093557
F53H1.3	2680	227.6394755
F11E6.7	2676	227.2997151
F28B3.9	2673	227.0448948
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Y37A1B.1	2671	226.8750145

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Y47G6A.29	2661	226.0256135
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F07A11.2	2635	223.8171708
T09A12.4	2635	223.8171708
C17G10.4	2630	223.3924703
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Y39A1A.1	2581	219.2304053
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ZK381.1	2573	218.5508845
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Y53F4B.22	2545	216.1725616
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T24A11.1	2537	215.4930408
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T01G1.3	2535	215.3231606
ZK484.3	2535	215.3231606
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F57B9.2	2517	213.7942387
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Y54G11A.8	2421	205.6399888
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W07E6.2	2399	203.7713066
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F54D5.14	2388	202.8369655
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C08B11.1	2369	201.2231035
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F25B5.6	2363	200.7134629
F48E8.5	2363	200.7134629

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H06O01.1	2360	200.4586426
K01G5.3	2354	199.949002
ZC155.1	2352	199.7791218
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F42A10.4	2350	199.6092416
Y111B2A.11	2349	199.5243014
C06G3.7	2347	199.3544212
F52C9.8	2346	199.2694811
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Y50D4C.5	2344	199.0996009
F55A11.3	2340	198.7598405
C25H3.6	2336	198.4200801
D1007.10	2336	198.4200801
C34E10.3	2332	198.0803197
R13H8.1	2330	197.9104395
C18E3.9	2329	197.8254994
Y47G6A.11	2329	197.8254994
Y39G8C.1	2328	197.7405593
ZK265.9	2328	197.7405593
B0240.4	2322	197.2309187
K03H1.2	2322	197.2309187
Y79H2A.3	2322	197.2309187
R03D7.1	2317	196.8062182
K08E3.6	2316	196.7212781
F49D11.9	2315	196.636338
F53A3.3	2315	196.636338
ZC376.5	2313	196.4664577
F29G9.2	2311	196.2965775
F31E3.4	2311	196.2965775
ZK520.4	2310	196.2116374
Y71F9AL.1	2308	196.0417572
R12E2.12	2307	195.9568171
F38A5.2	2306	195.871877
Y55F3BR.2	2302	195.5321166
F56D2.1	2301	195.4471765
F22G12.5	2299	195.2772963
Y43B11AR.4	2297	195.1074161
T20F5.7	2294	194.8525958
Y48C3A.11	2293	194.7676557
D1043.1	2290	194.5128354
F57C9.7	2286	194.173075
ZK632.1	2285	194.0881349
Y92H12BL.1	2284	194.0031948
Y106G6A.5	2283	193.9182547
F35G12.3	2282	193.8333146
F36A2.3	2280	193.6634344
B0511.10	2279	193.5784943

ZK1010.2	2277	193.408614
ZK1248.10	2275	193.2387338
C30G12.7	2273	193.0688536
W07E6.4	2272	192.9839135
Y60A3A.10	2272	192.9839135
R119.4	2271	192.8989734
K01D12.6	2268	192.6441531
Y97E10AL.2	2267	192.559213
Y40B1B.8	2266	192.4742729
Y54E2A.11	2265	192.3893328
Y113G7A.9	2263	192.2194526
R09B3.3	2262	192.1345125
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W07B3.2	2257	191.709812
T06D8.6	2252	191.2851115
M01G5.3	2251	191.2001714
Y73B6BL.9	2251	191.2001714
R06F6.8	2249	191.0302912
D1044.6	2248	190.9453511
F18H3.3	2247	190.860411
F26F4.12	2246	190.7754709
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C04A2.7	2242	190.4357105
Y24D9A.2	2240	190.2658302
C43E11.10	2239	190.1808901
F46C5.9	2236	189.9260698
Y69A2AR.31	2236	189.9260698
Y54E10A.4	2235	189.8411297
Y74C10AR.1	2233	189.6712495
Y55B1BR.5	2232	189.5863094
Y67H2A.10	2231	189.5013693
Y54E2A.8	2228	189.246549
C07D10.2	2227	189.1616089
F23A7.4	2227	189.1616089
F14D2.13	2225	188.9917287
F07C6.4	2224	188.9067886
T10B5.5	2224	188.9067886
F25H8.1	2222	188.7369084
C36B1.12	2221	188.6519683
F57C2.6	2220	188.5670282
R07E5.3	2219	188.4820881
F15B10.2	2217	188.3122079
F22F1.1	2217	188.3122079
Y119C1A.1	2217	188.3122079
Y54E5A.6	2216	188.2272678
F56A8.3	2215	188.1423277
C09H6.1	2214	188.0573876
K08F11.5	2214	188.0573876

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Y67H2A.8	2209	187.6326871
R05D11.5	2207	187.4628069
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Y67D2.4	2206	187.3778667
F28F8.2	2204	187.2079865
Y56A3A.20	2203	187.1230464
F28B3.8	2202	187.0381063
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F08H9.1	2192	186.1887053
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F38H4.9	2186	185.6790647
F57B10.4	2186	185.6790647
R53.7	2185	185.5941246
T03F6.1	2183	185.4242444
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F44E2.10	2171	184.4049632
F49C12.12	2171	184.4049632
F55B12.3	2171	184.4049632
Y54E5B.2	2171	184.4049632
Y116A8C.16	2164	183.8103824
C26E6.4	2163	183.7254423
C27D8.3	2161	183.5555621
F17C11.9	2161	183.5555621
Y51H1A.4	2156	183.1308616
C32D5.11	2155	183.0459215
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F44B9.8	2152	182.7911012
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Y38A8.3	2148	182.4513408
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Y49F6B.1	2137	181.5169997
F47G9.1	2134	181.2621793
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Y76B12C.2	2129	180.8374788
F38A5.13	2128	180.7525387
F55A12.1	2127	180.6675986
Y43F4B.7	2126	180.5826585
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Y63D3A.5	2124	180.4127783
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Y48A6B.3	2105	178.7989164
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C15H11.3	2103	178.6290362
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T13F2.6	2097	178.1193955
D1022.7	2095	177.9495153
F46F11.4	2092	177.694695
F40F8.9	2089	177.4398747
C30F8.2	2087	177.2699945
Y32G9A.8	2087	177.2699945
B0336.5	2085	177.1001143
F18C12.2	2082	176.845294
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F57B1.2	2080	176.6754138
Y17G7B.13	2080	176.6754138
Y37E3.9	2080	176.6754138
ZC434.8	2080	176.6754138
F39B2.4	2078	176.5055336

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F44B9.6	2073	176.0808331
Y47A7.1	2073	176.0808331
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Y48C3A.8	2068	175.6561326
T06E8.1	2066	175.4862524
T12E12.4	2066	175.4862524
Y38F2AR.12	2066	175.4862524
C48B4.9	2065	175.4013123
Y113G7A.8	2065	175.4013123
Y39G10AR.12	2065	175.4013123
F33E11.1	2064	175.3163722
C29E4.3	2063	175.2314321
Y53F4B.5	2062	175.1464919
C16A11.10	2061	175.0615518
D2085.6	2061	175.0615518
Y111B2A.4	2061	175.0615518
Y39A3CL.7	2056	174.6368513
F57C9.2	2055	174.5519112
F58F6.4	2055	174.5519112
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Y80D4G.1	2053	174.382031
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C06G4.1	2050	174.1272107
F43G6.1	2048	173.9573305
T24D1.3	2046	173.7874503
F55G1.6	2044	173.6175701
T19A5.1	2043	173.53263
F46F11.8	2040	173.2778097
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Y75B8A.24	2038	173.1079295
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W09G3.6	2032	172.5982889
K08D12.2	2031	172.5133488
T14B4.1	2031	172.5133488
Y56A3A.33	2031	172.5133488
C01B10.9	2029	172.3434686
C46A5.5	2029	172.3434686
Y54F10AM.11	2029	172.3434686
Y57A10A.27	2028	172.2585285
Y38C1AA.3	2026	172.0886482
C56E6.3	2025	172.0037081
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C17E4.5	2022	171.7488878
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Y71F9AL.17	2022	171.7488878

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C24H12.5	2016	171.2392472
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C50F4.11	2015	171.1543071
R11E3.8	2015	171.1543071
R107.5	2013	170.9844269
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F09C8.2	2008	170.5597264
F49D11.10	2007	170.4747863
K11D9.2	2007	170.4747863
Y37E3.17	2004	170.219966
Y39G10AR.8	2001	169.9651457
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T28A8.3	1999	169.7952655
F33H2.2	1995	169.4555051
C06E7.1	1994	169.370565
Y102E9.1	1994	169.370565
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Y38F2AR.5	1989	168.9458644
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F55G1.3	1987	168.7759842
C14C11.2	1986	168.6910441
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T22D1.5	1980	168.1814035
F10D11.2	1979	168.0964634
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Y67H2A.6	1974	167.6717629
C29H12.5	1973	167.5868228
ZC376.6	1968	167.1621223
ZC518.2	1968	167.1621223
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K08F9.4	1964	166.8223619
Y66D12A.23	1964	166.8223619
C50F2.2	1963	166.7374218
C16A11.3	1961	166.5675416
F59B8.2	1959	166.3976614
F41H10.3	1958	166.3127213
Y48A6B.6	1956	166.1428411
F53E4.1	1955	166.057901
F13H10.4	1952	165.8030806
R05D11.4	1952	165.8030806
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C39E9.12	1948	165.4633202
F01F1.4	1948	165.4633202
C06A5.3	1947	165.3783801
C01A2.3	1946	165.29344
F55A12.5	1944	165.1235598
T09E8.3	1944	165.1235598
F22D3.1	1943	165.0386197
F37D6.1	1943	165.0386197
Y38C1AA.12	1943	165.0386197
F10C2.4	1942	164.9536796
F59A6.6	1942	164.9536796
C18D11.2	1941	164.8687395
C34B2.6	1941	164.8687395
F56D1.1	1941	164.8687395
F35D6.1	1938	164.6139192
F55A11.4	1936	164.444039
C08B11.3	1934	164.2741588
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ZK662.4	1930	163.9343984
C54G4.7	1929	163.8494583
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C12D8.1	1921	163.1699375
F20H11.3	1921	163.1699375
F57B9.10	1919	163.0000572
Y48G8AL.6	1919	163.0000572
D2085.3	1916	162.7452369
Y105E8B.2	1916	162.7452369
Y47G6A.2	1915	162.6602968
Y62F5A.1	1915	162.6602968
C34E10.6	1914	162.5753567
F37E3.1	1914	162.5753567
F56A3.2	1912	162.4054765
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C04G2.6	1909	162.1506562
DY3.7	1909	162.1506562
Y75B12B.1	1908	162.0657161
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F55C5.7	1906	161.8958359
C49H3.10	1905	161.8108958
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K04G2.6	1902	161.5560755
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F18E2.3	1898	161.2163151
K08E3.7	1897	161.131375

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Y54E5A.7	1897	161.131375
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Y54E2A.3	1895	160.9614948
T08G11.1	1894	160.8765547
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Y48A6A.1	1887	160.281974
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Y37D8A.1	1886	160.1970339
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F58E10.1	1879	159.6024531
T05E8.3	1879	159.6024531
Y42H9AR.1	1878	159.517513
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ZK593.4	1877	159.4325729
Y111B2A.24	1875	159.2626927
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C30G12.6	1870	158.8379922
F44E2.2	1870	158.8379922
K02C4.3	1870	158.8379922
R08D7.6	1870	158.8379922
T04H1.4	1870	158.8379922
Y56A3A.17	1870	158.8379922
F29D10.4	1868	158.668112
F30H5.1	1868	158.668112
Y119D3B.11	1868	158.668112
C05C8.9	1865	158.4132917
F23C8.4	1865	158.4132917
Y59A8B.6	1862	158.1584714
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T08A11.1	1860	157.9885912
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Y75B12B.2	1854	157.4789506
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C24H11.7	1848	156.96931
K05C4.1	1848	156.96931
C52E4.2	1846	156.7994297

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M117.2	1845	156.7144896
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Y53G8AM.8	1844	156.6295495
F21A3.6	1841	156.3747292
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Y54G2A.26	1832	155.6102683
Y24F12A.2	1830	155.4403881
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F13D12.7	1826	155.1006277
F56C9.10	1825	155.0156876
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F28C6.6	1823	154.8458074
F54D5.8	1823	154.8458074
F54C8.3	1822	154.7608673
Y45F10A.2	1822	154.7608673
F10G7.2	1817	154.3361668
T05G5.1	1814	154.0813465
T23B5.1	1814	154.0813465
Y51H1A.2	1814	154.0813465
F32A7.4	1813	153.9964064
C36B1.4	1810	153.741586
M01A10.2	1810	153.741586
T25B9.8	1807	153.4867657
R144.4	1804	153.2319454
T09F3.3	1803	153.1470053
W03F8.4	1802	153.0620652
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H24K24.4	1801	152.9771251
K07F5.13	1801	152.9771251
Y34D9A.7	1801	152.9771251
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Y37D8A.9	1797	152.6373647
Y38C1AA.1	1796	152.5524246
Y54E10BL.6	1796	152.5524246
C13B9.4	1795	152.4674845
F10B5.7	1793	152.2976043
ZK792.5	1793	152.2976043
H25P06.2	1792	152.2126642
C18E3.2	1791	152.1277241
C46F11.2	1791	152.1277241
T07A9.6	1791	152.1277241
ZC404.9	1791	152.1277241
ZK652.6	1791	152.1277241
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C48B4.10	1785	151.6180835
Y102A5C.1	1785	151.6180835
Y105E8A.21	1784	151.5331434
C27H6.8	1783	151.4482033
F52F12.4	1783	151.4482033
C01G8.6	1782	151.3632632
C32D5.5	1782	151.3632632
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Y73B3A.11	1777	150.9385627
Y23H5A.3	1776	150.8536226
F33A8.3	1775	150.7686824
F55A12.3	1775	150.7686824
Y54G11A.11	1774	150.6837423
C08B6.7	1773	150.5988022
C14B1.4	1773	150.5988022
ZK616.5	1773	150.5988022
C50A2.2	1772	150.5138621
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ZK512.5	1766	150.0042215
F25B4.5	1765	149.9192814
T28A8.5	1765	149.9192814
T19E7.2	1764	149.8343413
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Y32B12B.4	1762	149.6644611
Y54G2A.31	1759	149.4096408
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F32B6.2	1748	148.4752997
Y76A2B.3	1748	148.4752997
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C06G3.9	1746	148.3054195
C55B7.9	1744	148.1355393
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T09B4.2	1743	148.0505992
Y73F8A.25	1743	148.0505992
R07G3.3	1741	147.880719

Y47G6A.20	1741	147.880719
R11D1.8	1740	147.7957789
Y41D4B.12	1740	147.7957789
ZK863.4	1740	147.7957789
Y65B4BL.4	1739	147.7108387
ZK1307.6	1739	147.7108387
C35D10.1	1737	147.5409585
E03A3.2	1737	147.5409585
Y106G6H.5	1737	147.5409585
B0261.2	1736	147.4560184
R02F11.4	1736	147.4560184
T07C4.7	1734	147.2861382
H38K22.1	1733	147.2011981
Y17G9B.9	1733	147.2011981
Y67D8B.4	1732	147.116258
H06I04.1	1730	146.9463778
C06E1.10	1728	146.7764976
F54C4.3	1728	146.7764976
R06C1.4	1727	146.6915575
F52C12.1	1725	146.5216773
F35F11.1	1722	146.266857
Y62E10A.2	1722	146.266857
F26E4.1	1721	146.1819169
R06C7.5	1721	146.1819169
Y111B2A.22	1720	146.0969768
ZC434.5	1719	146.0120367
AH6.5	1717	145.8421565
F44C4.4	1717	145.8421565
C18D11.1	1716	145.7572164
R119.7	1716	145.7572164
F23F1.8	1714	145.5873362
F25B3.1	1714	145.5873362
Y56A3A.2	1713	145.5023961
Y48B6A.1	1712	145.417456
ZK686.3	1712	145.417456
F42H11.2	1708	145.0776956
F59H5.1	1708	145.0776956
K04F10.4	1707	144.9927555
F59A7.7	1704	144.7379352
D2030.5	1703	144.652995
Y37D8A.22	1703	144.652995
R06F6.5	1700	144.3981747
Y52D3.1	1700	144.3981747
ZC302.2	1700	144.3981747
C29A12.1	1699	144.3132346
ZC247.1	1699	144.3132346
D2063.3	1695	143.9734742
T22C1.1	1693	143.803594

C01G5.6	1692	143.7186539
F31D4.3	1692	143.7186539
F48A11.4	1691	143.6337138
M01F1.4	1691	143.6337138
C01C7.1	1690	143.5487737
C44B11.6	1690	143.5487737
F09G2.9	1688	143.3788935
Y48G8AL.5	1687	143.2939534
Y54E5A.4	1687	143.2939534
Y39A1A.13	1685	143.1240732
F28C6.8	1681	142.7843128
Y32H12A.5	1679	142.6144326
Y45G5AM.8	1678	142.5294925
R07G3.7	1676	142.3596123
F14D2.2	1675	142.2746722
B0285.3	1674	142.1897321
F53A2.5	1674	142.1897321
C36B1.8	1673	142.104792
Y71F9AL.18	1673	142.104792
F33H2.1	1671	141.9349118
T21C9.2	1671	141.9349118
F54D10.3	1668	141.6800914
Y50D7A.6	1668	141.6800914
Y55B1AL.3	1667	141.5951513
F39H11.1	1666	141.5102112
H05L14.2	1666	141.5102112
C07F11.1	1665	141.4252711
C25A1.5	1663	141.2553909
C46C2.3	1662	141.1704508
Y50D4C.1	1661	141.0855107
M88.5	1657	140.7457503
T02G5.12	1656	140.6608102
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T01A4.1	1654	140.49093
K08H10.1	1653	140.4059899
H27A22.1	1652	140.3210498
C13B9.3	1651	140.2361097
R05H10.2	1651	140.2361097
T23G7.1	1651	140.2361097
F58B3.7	1650	140.1511696
K11H3.2	1650	140.1511696
T25D3.4	1650	140.1511696
Y42H9B.3	1650	140.1511696
C05C10.2	1649	140.0662295
T01B7.5	1649	140.0662295
Y45F10D.7	1649	140.0662295
C56E6.9	1648	139.9812894

R06A4.9	1648	139.9812894
C49H3.5	1647	139.8963493
F56A3.1	1647	139.8963493
C50C3.1	1642	139.4716488
B0511.12	1640	139.3017686
B0024.11	1639	139.2168285
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C48B6.6	1635	138.8770681
F57B10.3	1635	138.8770681
F33D11.9	1634	138.792128
T10F2.3	1634	138.792128
T26A5.6	1634	138.792128
F45F2.11	1633	138.7071879
Y71A12B.4	1632	138.6222477
C26D10.2	1629	138.3674274
T20D3.3	1629	138.3674274
W03G9.4	1629	138.3674274
F27C1.7	1628	138.2824873
F27D4.4	1627	138.1975472
Y48G9A.6	1627	138.1975472
F28B3.7	1626	138.1126071
Y55B1BR.4	1626	138.1126071
F26F4.7	1625	138.027667
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Y71D11A.1	1624	137.9427269
Y53C12A.1	1623	137.8577868
Y59C2A.3	1621	137.6879066
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Y66H1A.3	1619	137.5180264
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R07B5.9	1618	137.4330863
C41D11.8	1617	137.3481462
F14D2.4	1617	137.3481462
T09E8.2	1616	137.2632061
F01F1.5	1615	137.178266
F36F2.6	1615	137.178266
M106.2	1610	136.7535655
T03D3.5	1609	136.6686254
C14A4.4	1608	136.5836853
T20G5.14	1608	136.5836853
F18A11.1	1607	136.4987452
F42A10.5	1607	136.4987452
T13H5.8	1607	136.4987452
K01G5.5	1606	136.4138051
C44B9.5	1605	136.328865
F45F2.10	1605	136.328865
C55B7.1	1604	136.2439249

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K08E3.8	1602	136.0740447
Y39B6A.36	1602	136.0740447
ZC302.1	1602	136.0740447
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Y73F8A.27	1599	135.8192244
C25A1.10	1598	135.7342843
F32D1.9	1597	135.6493442
T12F5.5	1596	135.564404
Y116A8C.36	1595	135.4794639
R05F9.1	1593	135.3095837
ZK370.4	1593	135.3095837
F37C12.9	1590	135.0547634
F54D5.7	1590	135.0547634
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Y59A8B.1	1589	134.9698233
F23H11.4	1588	134.8848832
ZK402.5	1588	134.8848832
D2005.5	1587	134.7999431
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C06H2.3	1585	134.6300629
C49C3.6	1585	134.6300629
ZC404.3	1585	134.6300629
W07E6.1	1584	134.5451228
Y37A1B.2	1584	134.5451228
Y37B11A.3	1584	134.5451228
T22B11.5	1583	134.4601827
C14A4.10	1582	134.3752426
W02D3.10	1582	134.3752426
M110.5	1580	134.2053624
T20H4.4	1580	134.2053624
Y37D8A.6	1580	134.2053624
R01H2.3	1577	133.9505421
Y18D10A.19	1577	133.9505421
Y41E3.10	1577	133.9505421
Y75B8A.7	1575	133.7806619
F55A3.2	1574	133.6957218
K01G5.9	1572	133.5258416
D2085.5	1571	133.4409015
T07F8.3	1571	133.4409015
C08F8.3	1570	133.3559614
D1022.1	1569	133.2710213
T21B10.3	1569	133.2710213
T03F1.1	1568	133.1860812
F54A3.2	1567	133.1011411
F54D11.4	1567	133.1011411
F31E3.5	1566	133.016201

K02B2.1	1566	133.016201
R09B3.2	1566	133.016201
Y111B2A.20	1566	133.016201
Y23H5B.7	1566	133.016201
Y42G9A.4	1566	133.016201
Y54E10A.15	1565	132.9312609
Y32B12B.2	1564	132.8463208
F41E6.13	1563	132.7613807
R06A4.2	1563	132.7613807
W03F9.1	1563	132.7613807
ZK757.4	1562	132.6764406
F01F1.9	1561	132.5915005
Y57G11C.9	1561	132.5915005
F40B1.1	1556	132.1667999
F37C12.13	1555	132.0818598
R13A5.12	1555	132.0818598
W09B6.3	1554	131.9969197
Y67D8C.10	1554	131.9969197
Y53F4B.3	1553	131.9119796
F52C9.3	1552	131.8270395
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C05D11.2	1548	131.4872791
F22B5.9	1548	131.4872791
F52H3.4	1548	131.4872791
F42G8.10	1546	131.3173989
W02G9.3	1544	131.1475187
W08D2.7	1544	131.1475187
C41C4.8	1543	131.0625786
C44E4.4	1541	130.8926984
ZK180.3	1539	130.7228182
C38C3.5	1535	130.3830578
T27E9.3	1535	130.3830578
W02A2.6	1535	130.3830578
ZK675.2	1535	130.3830578
B0564.7	1533	130.2131776
K04G2.8	1533	130.2131776
Y67D2.2	1533	130.2131776
C26C6.2	1532	130.1282375
T01C3.9	1531	130.0432974
Y47H9C.8	1531	130.0432974
C04A2.3	1530	129.9583573
Y47G6A.23	1527	129.703537
F22D6.3	1526	129.6185969
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R102.5	1526	129.6185969

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Y48B6A.11	1522	129.2788364
Y54E2A.2	1522	129.2788364
F54E7.7	1521	129.1938963
Y111B2A.14	1521	129.1938963
ZK809.4	1521	129.1938963
T22C1.3	1520	129.1089562
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F55A11.2	1518	128.939076
T23G4.3	1518	128.939076
Y82E9BR.2	1518	128.939076
C07E3.1	1516	128.7691958
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ZK1248.3	1512	128.4294354
C01G8.9	1510	128.2595552
T12E12.1	1510	128.2595552
Y45F10D.3	1509	128.1746151
ZK353.8	1508	128.089675
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F30F8.9	1505	127.8348547
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Y97E10AR.6	1503	127.6649745
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F59E12.1	1501	127.4950943
K12H4.3	1501	127.4950943
W03F9.2	1501	127.4950943
Y77E11A.10	1501	127.4950943
F55A3.1	1500	127.4101542
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F49D11.1	1495	126.9854537
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Y105E8A.19	1494	126.9005136
C13F10.6	1492	126.7306334
C47D12.8	1492	126.7306334
C46A5.9	1491	126.6456933
F16D3.2	1491	126.6456933
C23H3.5	1490	126.5607532
Y59A8B.23	1490	126.5607532
F56C9.1	1489	126.4758131
C06A5.9	1486	126.2209927
F16D3.4	1486	126.2209927

F48E8.3	1485	126.1360526
F45G2.7	1483	125.9661724
C46G7.5	1482	125.8812323
Y49F6B.4	1482	125.8812323
Y49G5B.1	1482	125.8812323
C17G10.1	1479	125.626412
F45G2.10	1479	125.626412
F57B10.11	1479	125.626412
Y51H7C.11	1479	125.626412
F59C6.5	1478	125.5414719
T01B7.6	1478	125.5414719
F08B4.1	1477	125.4565318
T20B12.3	1477	125.4565318
F58A4.2	1476	125.3715917
R10D12.14	1476	125.3715917
Y41C4A.9	1476	125.3715917
T07C4.1	1475	125.2866516
T22F3.2	1475	125.2866516
Y69A2AR.16	1474	125.2017115
Y87G2A.7	1474	125.2017115
C24G6.3	1471	124.9468912
R06C1.1	1471	124.9468912
ZC513.6	1471	124.9468912
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Y47D3A.26	1467	124.6071308
F23B12.6	1463	124.2673704
F25D7.1	1463	124.2673704
F43G9.3	1463	124.2673704
T02E1.3	1463	124.2673704
F59A3.2	1462	124.1824303
ZK1127.7	1462	124.1824303
F26D2.3	1461	124.0974902
K10C3.2	1459	123.92761
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T24H7.2	1456	123.6727897
R12C12.8	1455	123.5878496
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F54E7.8	1447	122.9083287
T09F3.2	1447	122.9083287
T28B11.1	1447	122.9083287
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K01G5.8	1443	122.5685683

T02E1.2	1443	122.5685683
F28B3.10	1441	122.3986881
T09B4.1	1441	122.3986881
C47B2.4	1440	122.313748
R13F6.10	1440	122.313748
W06A7.3	1440	122.313748
C16A3.4	1439	122.2288079
F59B2.6	1439	122.2288079
F46B6.6	1438	122.1438678
W06D4.6	1438	122.1438678
C03D6.8	1437	122.0589277
F43G9.5	1437	122.0589277
Y59A8B.10	1437	122.0589277
B0511.2	1436	121.9739876
C35D10.6	1436	121.9739876
D1014.8	1436	121.9739876
C32F10.1	1435	121.8890475
D2085.4	1435	121.8890475
F08F8.2	1435	121.8890475
F25G6.1	1433	121.7191673
F52C6.10	1433	121.7191673
Y18H1A.7	1433	121.7191673
Y73E7A.9	1431	121.5492871
F33G12.5	1430	121.464347
F44E2.7	1430	121.464347
Y55F3AL.1	1430	121.464347
Y38A10A.5	1429	121.3794069
Y55B1AR.2	1429	121.3794069
C01B4.9	1427	121.2095267
Y37H2A.5	1427	121.2095267
T13B5.8	1426	121.1245866
Y77E11A.7	1426	121.1245866
M01E11.3	1423	120.8697663
ZK829.7	1423	120.8697663
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F43D9.3	1413	120.0203652
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T07A5.6	1398	118.7462637
Y48E1B.5	1398	118.7462637
Y116A8A.9	1395	118.4914434
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Y73F8A.33	1392	118.2366231
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F56D1.7	1390	118.0667429
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Y23H5A.7	1387	117.8119226
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C37C3.2	1385	117.6420424
K03H4.2	1385	117.6420424
R151.7	1385	117.6420424
Y54E10A.10	1384	117.5571023
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C34E10.4	1382	117.3872221
K04G7.10	1382	117.3872221
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Y43C5A.6	1382	117.3872221
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Y71F9B.10	1381	117.3022819
F20D6.4	1380	117.2173418
T10E9.1	1380	117.2173418
Y44E3A.1	1380	117.2173418
T24B1.1	1378	117.0474616
F15D3.6	1377	116.9625215
R11A5.2	1377	116.9625215
F26H11.6	1376	116.8775814
C47G2.4	1375	116.7926413
K11D2.5	1373	116.6227611
C05D11.8	1372	116.537821
C41G7.4	1372	116.537821
R107.4	1372	116.537821
F27D4.5	1371	116.4528809
VF36H2L.1	1371	116.4528809

Y41D4B.4	1371	116.4528809
ZC53.6	1371	116.4528809
ZK484.4	1371	116.4528809
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K12C11.1	1368	116.1980606
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ZC376.7	1367	116.1131205
F18C5.3	1366	116.0281804
F36A2.9	1365	115.9432403
K08F9.2	1365	115.9432403
C05C8.6	1364	115.8583002
F10E9.8	1364	115.8583002
F52B11.1	1363	115.7733601
Y76A2B.1	1363	115.7733601
F43C1.6	1362	115.68842
F59A7.9	1360	115.5185398
F14D2.14	1359	115.4335997
C17D12.7	1358	115.3486596
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Y55D9A.1	1357	115.2637195
Y66D12A.17	1357	115.2637195
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M03C11.7	1346	114.3293784
Y71F9B.8	1346	114.3293784
K02F3.11	1344	114.1594981
T02G5.8	1344	114.1594981
Y45F10D.12	1343	114.074558
Y53H1C.2	1343	114.074558
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W02B12.8	1342	113.9896179
C13B9.2	1341	113.9046778
C43E11.1	1341	113.9046778
R06A4.6	1341	113.9046778
F59E12.9	1340	113.8197377
Y47D7A.16	1340	113.8197377
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F58E10.4	1339	113.7347976
C26C6.3	1338	113.6498575
C27H5.3	1338	113.6498575
F48C1.5	1338	113.6498575

F25B4.1	1337	113.5649174
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B0412.3	1336	113.4799773
F53B7.3	1334	113.3100971
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Y87G2A.11	1334	113.3100971
F58G11.1	1333	113.225157
K09H9.7	1332	113.1402169
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T23B3.1	1332	113.1402169
Y110A2AR.1	1331	113.0552768
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W04A8.7	1330	112.9703367
Y47D3A.6	1329	112.8853966
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C10H11.1	1328	112.8004565
T19A6.1	1328	112.8004565
Y39A1C.2	1326	112.6305763
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M01D7.7	1325	112.5456362
C27H6.9	1323	112.375756
F53F4.11	1323	112.375756
K01C8.3	1323	112.375756
T19A6.2	1323	112.375756
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C52E4.4	1320	112.1209357
F21D5.1	1320	112.1209357
Y108G3AL.7	1320	112.1209357
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Y87G2A.13	1319	112.0359956
Y105E8A.10	1317	111.8661154
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Y55F3BR.8	1297	110.1673133
Y75B8A.33	1297	110.1673133
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Y41E3.9	1296	110.0823732
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Y71F9AL.16	1294	109.912493
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F33E11.3	1275	108.2986311
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F59E10.2	1251	106.2600686
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Y54E10A.11	1248	106.0052483
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T21B10.4	1244	105.6654879
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Y110A2AM.3	1241	105.4106676
Y39B6A.35	1241	105.4106676
Y51A2D.7	1241	105.4106676
Y67H2A.4	1240	105.3257275
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R151.9	1236	104.985967
Y111B2A.19	1236	104.985967
C13G5.2	1235	104.9010269
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Y53F4B.21	1235	104.9010269
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Y71G12B.15	1230	104.4763264
C26E6.6	1229	104.3913863
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T23G7.4	1195	101.5034228
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F22D6.5	1185	100.6540218
T23B12.3	1185	100.6540218
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C53D6.4	1183	100.4841416
F18A1.2	1183	100.4841416
T26A5.1	1183	100.4841416
Y48E1B.12	1182	100.3992015
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F29D11.2	1181	100.3142614
F57A10.3	1180	100.2293213
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Y62E10A.14	1180	100.2293213
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Y47G6A.7	1172	99.54980047
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F54A3.3	1169	99.29498016
K07C5.1	1169	99.29498016
Y45F3A.3	1169	99.29498016
Y53F4B.13	1168	99.21004006
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C55B7.11	1165	98.95521975
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Y80D3A.2	1165	98.95521975
Y37H2A.1	1164	98.87027964
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Y47D3A.22	1161	98.61545934
Y49F6B.2	1161	98.61545934
C05D2.6	1160	98.53051923
T05F1.2	1160	98.53051923
Y65B4BR.5	1160	98.53051923
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F43E2.8	1159	98.44557913
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Y17G7B.15	1151	97.76605831
Y92H12BR.8	1151	97.76605831
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Y59A8B.13	1147	97.4262979
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Y39C12A.8	1145	97.25641769
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F54E12.3	1135	96.40701666
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Y48A6B.10	1135	96.40701666
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C14C10.4	1132	96.15219636
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Y110A7A.8	1128	95.81243594
Y48G1A.6	1128	95.81243594
F23C8.5	1127	95.72749584
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F23B12.5	1124	95.47267553
C03A7.2	1122	95.30279533
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C41D11.3	1115	94.70821461
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Y104H12D.3	1114	94.62327451

Y113G7B.18	1114	94.62327451
C18A3.2	1113	94.5383344
Y57A10A.16	1113	94.5383344
Y76A2A.2	1113	94.5383344
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Y54E10BR.6	1109	94.19857399
F41G3.6	1107	94.02869379
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Y54G2A.17	1107	94.02869379
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Y57G11C.11	1105	93.85881358
C25D7.8	1104	93.77387348
F10B5.1	1104	93.77387348
Y38H6C.10	1104	93.77387348
Y55F3BR.10	1104	93.77387348
C44B7.2	1103	93.68893337
F32E10.6	1103	93.68893337
Y111B2A.8	1103	93.68893337
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Y48C3A.14	1102	93.60399327
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F32E10.1	1100	93.43411307
Y34D9A.10	1100	93.43411307
Y71F9AL.4	1100	93.43411307
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Y71H2AM.23	1098	93.26423286
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F43E2.7	1095	93.00941255
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C06A8.2	1093	92.83953235
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Y49E10.6	1084	92.07507142
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ZC317.7	1076	91.3955506
F28B3.6	1075	91.3106105
T16G12.5	1075	91.3106105
Y41D4A.6	1074	91.22567039
ZK973.3	1074	91.22567039
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F10G7.8	1072	91.05579019
F57H12.1	1072	91.05579019
T09A5.8	1072	91.05579019
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Y75B8A.8	1071	90.97085009
ZC168.3	1071	90.97085009
F20B6.5	1068	90.71602978
F53C3.13	1068	90.71602978
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Y105E8A.12	1068	90.71602978
Y48E1C.4	1068	90.71602978
Y64H9A.1	1068	90.71602978
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F59A2.4	1061	90.12144906
T10B11.3	1061	90.12144906
Y54G11A.3	1061	90.12144906
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F25H2.6	1060	90.03650896
M01E11.2	1060	90.03650896

F58B3.6	1059	89.95156885
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F39B2.1	1058	89.86662875
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Y48E1B.14	1054	89.52686834
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Y39G10AR.9	1051	89.27204803
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F59G1.3	1048	89.01722772
T05H4.12	1048	89.01722772
Y47H9C.7	1048	89.01722772
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ZC410.3	1047	88.93228762
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F25B5.4	1046	88.84734752
F53F10.4	1046	88.84734752
F46C5.8	1045	88.76240741
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C14B1.12	1043	88.59252721
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Y24D9A.4	1041	88.422647
F18A1.6	1040	88.3377069
C32D5.9	1039	88.2527668
F28C6.2	1039	88.2527668
F30A10.10	1039	88.2527668
Y95B8A.11	1039	88.2527668
H26D21.1	1038	88.16782669
W06F12.1	1038	88.16782669
Y17G7B.20	1038	88.16782669
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F59A2.2	1037	88.08288659
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Y48G10A.2	1036	87.99794649
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ZK795.3	1035	87.91300639
Y47G6A.10	1034	87.82806628
Y53F4B.12	1033	87.74312618
R09B3.1	1032	87.65818608
Y53G8AR.8	1032	87.65818608
Y71H2AM.11	1031	87.57324597

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Y57A10A.3	1030	87.48830587
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D2013.2	1029	87.40336577
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Y54H5A.3	1029	87.40336577
C07H6.4	1028	87.31842567
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F20C5.2	1027	87.23348556
B0285.7	1026	87.14854546
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F52B5.5	1019	86.55396474
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F39B2.10	1012	85.95938402
Y106G6H.14	1012	85.95938402
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Y23H5A.8	1011	85.87444392
C34D4.4	1010	85.78950382
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Y55F3BL.2	997	84.68528248
Y71H2AM.9	997	84.68528248
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Y116A8C.32	991	84.17564186
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Y39A1A.5	988	83.92082155
Y57G11C.33	988	83.92082155
Y71G12B.1	988	83.92082155
Y75B8A.30	988	83.92082155
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T27A3.2	987	83.83588145
Y38F2AL.1	987	83.83588145
Y73E7A.6	987	83.83588145
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T07A9.2	986	83.75094135
T23F11.1	986	83.75094135

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Y47D3A.27	968	82.2220195
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F01F1.8	956	81.20273827
Y37E11AR.2	956	81.20273827
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Y41E3.4	952	80.86297785
Y71A12B.12	952	80.86297785
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C26E6.11	949	80.60815755
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F59E10.3	946	80.35333724
Y76B12C.8	946	80.35333724
ZK632.6	946	80.35333724
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F32A5.6	944	80.18345703
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F09F7.4	943	80.09851693
F42A6.5	943	80.09851693
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F58D2.4	941	79.92863672
W09C5.1	941	79.92863672
Y37E11B.5	940	79.84369662
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F11A10.6	939	79.75875652
F36H2.2	939	79.75875652
T22C1.10	939	79.75875652
F13A7.14	938	79.67381641
R11A5.1	938	79.67381641
T01C3.6	938	79.67381641

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K10B2.1	937	79.58887631
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F09D1.1	935	79.41899611
F37C12.7	935	79.41899611
T07C12.12	935	79.41899611
Y42G9A.1	935	79.41899611
Y45F10A.6	934	79.334056
Y48G10A.4	934	79.334056
Y73B3A.18	934	79.334056
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R01B10.1	932	79.1641758
T02C12.3	932	79.1641758
Y48G1C.5	932	79.1641758
Y57A10A.20	931	79.0792357
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Y105E8B.3	930	78.99429559
Y32F6A.1	930	78.99429559
C08F8.2	929	78.90935549
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F42G8.12	929	78.90935549
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T10F2.5	929	78.90935549
Y47D3A.28	929	78.90935549
F58H7.7	928	78.82441539
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Y51H1A.3	928	78.82441539
Y59E9AL.7	928	78.82441539
Y110A7A.15	927	78.73947528
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F32B6.9	926	78.65453518
F56H1.4	926	78.65453518
F58G11.5	926	78.65453518
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Y105E8A.23	922	78.31477477
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K04F10.6	920	78.14489456
R06F6.9	920	78.14489456
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B0261.1	914	77.63525395
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F40F8.1	914	77.63525395
Y41E3.1	914	77.63525395
C44B12.6	913	77.55031385
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F22D6.6	913	77.55031385
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B0491.1	912	77.46537374
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C09G9.6	910	77.29549354
C50F4.14	910	77.29549354
Y37E11C.1	910	77.29549354
Y43F4B.5	910	77.29549354
Y60A3A.9	910	77.29549354
C53H9.3	909	77.21055343
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Y49F6B.9	909	77.21055343
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D2023.4	901	76.53103261
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ZK546.1	898	76.2762123
C18E3.7	897	76.1912722
Y71G12B.12	897	76.1912722
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B0303.4	895	76.021392
F08B4.5	895	76.021392
F57C9.1	895	76.021392
T27A3.7	895	76.021392

Y48E1B.13	893	75.85151179
C08C3.4	891	75.68163158
C17H12.13	891	75.68163158
C37A2.2	891	75.68163158
C45B11.1	891	75.68163158
F57B10.7	891	75.68163158
W02B12.11	891	75.68163158
K07F5.14	890	75.59669148
R11H6.2	890	75.59669148
Y66D12A.21	889	75.51175138
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F10E7.5	888	75.42681128
H31G24.4	888	75.42681128
H37N21.1	887	75.34187117
F33D11.8	886	75.25693107
C15C8.4	885	75.17199097
VF39H2L.1	885	75.17199097
Y39B6A.33	884	75.08705086
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E01G4.4	883	75.00211076
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Y79H2A.6	880	74.74729045
F32H2.3	879	74.66235035
M18.8	879	74.66235035
PAR2.4	879	74.66235035
Y48G1C.6	879	74.66235035
C29E4.8	878	74.57741025
C48A7.2	878	74.57741025
T12D8.2	878	74.57741025
T28F3.1	878	74.57741025
Y116A8C.35	878	74.57741025
F44G4.1	877	74.49247014
W06B4.3	876	74.40753004
Y54E10A.6	876	74.40753004
Y55F3AM.4	876	74.40753004
F25H2.7	875	74.32258994
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W03C9.7	875	74.32258994
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F07F6.8	873	74.15270973
F13C5.2	873	74.15270973
Y94H6A.5	872	74.06776963
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CC8.2	871	73.98282953
F27D4.2	871	73.98282953

K08D12.3	871	73.98282953
DY3.4	870	73.89788943
F21D5.2	870	73.89788943
C25A1.9	868	73.72800922
Y55F3BR.1	868	73.72800922
D1046.2	867	73.64306912
ZK40.1	867	73.64306912
AC8.12	866	73.55812901
K03E5.1	866	73.55812901
W08F4.9	865	73.47318891
Y42H9AR.3	865	73.47318891
C12C8.3	864	73.38824881
D2045.9	864	73.38824881
W08F4.7	864	73.38824881
F48A11.1	863	73.30330871
F52F12.3	863	73.30330871
Y74C9A.3	863	73.30330871
F52C6.4	862	73.2183686
F59C6.4	862	73.2183686
F25B5.5	861	73.1334285
F38A1.8	861	73.1334285
R05F9.6	861	73.1334285
F47B10.1	860	73.0484884
T28D6.4	860	73.0484884
Y57E12AL.1	859	72.96354829
Y71F9AL.14	859	72.96354829
C02F5.6	857	72.79366809
C16C8.11	857	72.79366809
F56B3.12	857	72.79366809
Y37E11B.3	857	72.79366809
ZK177.4	857	72.79366809
F07A11.3	856	72.70872799
F37H8.6	856	72.70872799
F46F11.6	856	72.70872799
Y45G5AM.7	856	72.70872799
Y92C3B.2	856	72.70872799
D1037.1	855	72.62378788
F56C9.6	855	72.62378788
Y45F10D.11	855	72.62378788
C07H6.1	854	72.53884778
F31E3.1	854	72.53884778
F32D8.14	854	72.53884778
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F58H1.1	853	72.45390768
H21P03.1	853	72.45390768
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Y47D3A.25	853	72.45390768
Y55F3BL.1	853	72.45390768

C01H6.6	852	72.36896758
F25H9.5	852	72.36896758
F53G2.7	852	72.36896758
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C52E12.1	848	72.02920716
Y18H1A.4	848	72.02920716
Y62E10A.10	848	72.02920716
Y43H11AL.1	847	71.94426706
B0238.10	846	71.85932696
Y110A2AL.14	846	71.85932696
ZK1055.7	846	71.85932696
F52B11.2	845	71.77438686
B0361.7	844	71.68944675
C55B7.8	844	71.68944675
Y38A10A.6	844	71.68944675
Y73B3A.4	844	71.68944675
C05C8.5	843	71.60450665
F26F4.5	843	71.60450665
F45E4.10	843	71.60450665
R13H4.4	843	71.60450665
T12G3.4	842	71.51956655
Y67D8C.3	842	71.51956655
Y40B10A.2	840	71.34968634
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Y105E8A.24	839	71.26474624
Y75B8A.14	839	71.26474624
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F42A10.1	838	71.17980614
Y59A8B.11	838	71.17980614
C01F6.8	837	71.09486603
C35D10.9	837	71.09486603
Y73B6BL.30	837	71.09486603
F35H8.3	836	71.00992593
K07E8.7	835	70.92498583
R11E3.6	834	70.84004573
T27E9.7	834	70.84004573
Y51F10.4	834	70.84004573
C09G4.5	833	70.75510562
M106.5	833	70.75510562
F21H12.1	832	70.67016552
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T01E8.4	832	70.67016552

F55H2.5	831	70.58522542
K02F6.1	831	70.58522542
Y54E5A.5	831	70.58522542
Y54F10AM.4	831	70.58522542
Y54E10BR.2	830	70.50028531
F22B7.5	829	70.41534521
F52B5.6	828	70.33040511
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Y45F10C.6	828	70.33040511
F35D11.4	827	70.24546501
F25D7.2	826	70.1605249
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T03F1.3	826	70.1605249
W05F2.6	826	70.1605249
Y110A7A.10	826	70.1605249
Y48B6A.12	826	70.1605249
Y55F3AM.13	825	70.0755848
Y45F3A.2	824	69.9906447
Y69A2AR.6	824	69.9906447
C26E6.8	823	69.90570459
F49D11.8	823	69.90570459
H17B01.4	823	69.90570459
F47G6.4	822	69.82076449
F59A3.12	822	69.82076449
F56D12.1	821	69.73582439
T11G6.2	821	69.73582439
F25B4.4	820	69.65088429
ZK546.14	820	69.65088429
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F56D12.4	819	69.56594418
T07A9.5	819	69.56594418
Y48E1B.3	819	69.56594418
C01G8.1	818	69.48100408
C56C10.7	817	69.39606398
F19B10.5	817	69.39606398
F42G8.3	817	69.39606398
D2013.9	815	69.22618377
F32D8.5	815	69.22618377
Y47G6A.18	815	69.22618377
Y63D3A.6	815	69.22618377
Y71G12B.10	815	69.22618377
Y87G2A.4	815	69.22618377
C23G10.3	814	69.14124367
C35B1.2	814	69.14124367
C07G1.8	813	69.05630357
F10C2.2	813	69.05630357
F54H12.6	813	69.05630357
R04E5.8	813	69.05630357

Y65B4A.1	813	69.05630357
B0334.11	812	68.97136346
R08D7.4	812	68.97136346
C30B5.1	811	68.88642336
T24C4.5	811	68.88642336
Y45G12B.1	810	68.80148326
Y56A3A.28	810	68.80148326
C53A5.6	809	68.71654316
W04A8.1	809	68.71654316
ZK1307.8	809	68.71654316
C17G10.2	808	68.63160305
R10E8.6	808	68.63160305
F52A8.5	807	68.54666295
F10E7.6	806	68.46172285
K08E7.1	805	68.37678274
C18D11.4	804	68.29184264
W05F2.2	804	68.29184264
C25A1.12	803	68.20690254
F01G4.3	803	68.20690254
T19C3.8	803	68.20690254
Y43F8C.7	803	68.20690254
C16A3.2	802	68.12196244
F28B3.1	802	68.12196244
ZK945.2	802	68.12196244
F27C1.2	801	68.03702233
F54D5.9	801	68.03702233
K06A5.8	801	68.03702233
W08E12.7	801	68.03702233
Y39E4B.10	801	68.03702233
ZK856.1	801	68.03702233
C34C12.4	800	67.95208223
F23F1.9	800	67.95208223
Y39A1A.6	800	67.95208223
Y74C9A.1	800	67.95208223
C33H5.9	799	67.86714213
K04C2.4	799	67.86714213
R13A5.1	798	67.78220202
C32A3.2	797	67.69726192
R144.11	797	67.69726192
C41D11.2	796	67.61232182
F45D3.5	796	67.61232182
F55D10.3	796	67.61232182
M01B12.5	795	67.52738172
Y69A2AR.18	795	67.52738172
C48B6.2	794	67.44244161
DC2.3	794	67.44244161
Y51H1A.6	794	67.44244161
Y54E10A.2	794	67.44244161

H06O01.2	793	67.35750151
T10D4.6	793	67.35750151
F57A8.2	792	67.27256141
H06I04.4	792	67.27256141
Y37H9A.1	792	67.27256141
C34B2.8	791	67.18762131
T09A5.15	791	67.18762131
Y71A12B.1	791	67.18762131
Y38F2AR.3	790	67.1026812
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C35D10.5	789	67.0177411
F55F8.6	789	67.0177411
K04G7.1	789	67.0177411
K08A2.1	789	67.0177411
R10H10.1	789	67.0177411
T05H4.6	789	67.0177411
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Y51H4A.15	787	66.84786089
C24B5.2	786	66.76292079
R144.6	786	66.76292079
C17E4.10	785	66.67798069
D2092.5	785	66.67798069
W06D4.4	785	66.67798069
F26B1.3	784	66.59304059
F46B6.7	784	66.59304059
T04A8.15	784	66.59304059
C27C7.1	783	66.50810048
C27D11.1	783	66.50810048
C09E7.7	781	66.33822028
F31C3.4	780	66.25328017
T26A5.2	779	66.16834007
R144.3	778	66.08339997
T28D9.10	778	66.08339997
C16C10.6	777	65.99845987
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C30H6.8	775	65.82857966
F46F11.10	775	65.82857966
F55G1.9	775	65.82857966
W02D3.9	775	65.82857966
Y38C1AA.14	775	65.82857966
ZK418.4	775	65.82857966
Y54F10BM.1	774	65.74363956
C09E7.8	773	65.65869945
C44B9.1	773	65.65869945
F26F4.11	773	65.65869945
F37C12.11	773	65.65869945
R07E5.10	773	65.65869945

Y19D10A.12	773	65.65869945
C25H3.4	772	65.57375935
F20D12.4	772	65.57375935
F42G8.4	771	65.48881925
K07C11.9	771	65.48881925
Y39A3CR.1	771	65.48881925
Y39H10A.3	771	65.48881925
Y75B7AL.3	771	65.48881925
F41G3.12	770	65.40387915
T21C9.1	770	65.40387915
Y53G8AL.2	770	65.40387915
Y53G8AR.2	770	65.40387915
Y71G12B.35	770	65.40387915
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Y73B6BL.3	769	65.31893904
ZK856.8	769	65.31893904
B0495.8	768	65.23399894
F43C1.2	768	65.23399894
T27F6.6	768	65.23399894
B0303.3	766	65.06411874
F40F11.1	766	65.06411874
F59H6.9	766	65.06411874
T19B4.5	766	65.06411874
F33D4.5	765	64.97917863
T06D8.9	765	64.97917863
Y39A1A.12	765	64.97917863
F56A6.4	763	64.80929843
F56H1.5	763	64.80929843
K11H12.8	762	64.72435832
VC5.4	762	64.72435832
Y57A10A.5	762	64.72435832
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F07B7.2	760	64.55447812
Y23H5B.5	760	64.55447812
Y82E9BR.22	760	64.55447812
C41G7.9	759	64.46953802
T16G12.6	759	64.46953802
Y53C12A.4	759	64.46953802
Y32H12A.7	758	64.38459791
Y46G5A.17	757	64.29965781
Y94H6A.9	756	64.21471771
C05D2.10	755	64.1297776
Y18H1A.6	755	64.1297776
Y87G2A.6	755	64.1297776
C15C8.7	754	64.0448375
F40F8.11	754	64.0448375
ZC155.7	754	64.0448375
C24F3.4	753	63.9598974

W01G7.3	753	63.9598974
Y56A3A.36	753	63.9598974
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C38D9.2	751	63.79001719
F53F4.16	751	63.79001719
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T26G10.1	751	63.79001719
Y59A8B.22	751	63.79001719
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K04G2.3	750	63.70507709
M01F1.6	750	63.70507709
T24D1.1	750	63.70507709
ZK858.6	750	63.70507709
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C08F11.7	749	63.62013699
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F59E10.1	749	63.62013699
Y39F10B.1	749	63.62013699
Y41D4B.5	749	63.62013699
Y66D12A.5	749	63.62013699
B0564.1	748	63.53519689
R107.7	748	63.53519689
W06A11.4	748	63.53519689
F09E5.7	747	63.45025678
F23A7.8	747	63.45025678
K08E3.5	747	63.45025678
C16C10.10	746	63.36531668
R06C7.7	746	63.36531668
R07H5.9	746	63.36531668
Y54G2A.22	746	63.36531668
ZK430.7	746	63.36531668
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Y92H12BL.4	745	63.28037658
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D2096.4	744	63.19543647
Y74C9A.4	744	63.19543647
C14B9.10	743	63.11049637
F18E2.2	743	63.11049637
Y80D3A.1	743	63.11049637
C33F10.14	742	63.02555627
M18.6	742	63.02555627
C56A3.4	741	62.94061617
K11D2.3	741	62.94061617
T01H3.1	741	62.94061617
Y73B6BL.7	741	62.94061617

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F01F1.3	740	62.85567606
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F53A2.7	739	62.77073596
F56B3.2	738	62.68579586
R17.1	738	62.68579586
Y108G3AL.1	738	62.68579586
Y65B4A.6	737	62.60085575
M04B2.4	736	62.51591565
T01H3.3	736	62.51591565
Y71A12B.11	736	62.51591565
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E02H1.4	735	62.43097555
K08F11.4	735	62.43097555
H14E04.2	734	62.34603545
Y44E3A.4	734	62.34603545
ZK1010.4	733	62.26109534
C41H7.4	732	62.17615524
D2024.5	732	62.17615524
C47E12.7	731	62.09121514
Y48G1C.4	731	62.09121514
F08F8.4	730	62.00627504
F33G12.3	730	62.00627504
R148.1	730	62.00627504
Y47D7A.14	730	62.00627504
F13B12.1	729	61.92133493
C06H2.1	728	61.83639483
F14B4.2	728	61.83639483
F22D6.8	728	61.83639483
ZK185.2	728	61.83639483
K02F3.12	727	61.75145473
T14G10.7	727	61.75145473
W03B1.4	726	61.66651462
C47G2.3	725	61.58157452
D2024.6	725	61.58157452
R74.1	725	61.58157452
F18C5.2	724	61.49663442
F26E4.10	724	61.49663442
F39H11.3	723	61.41169432
K02F2.1	723	61.41169432
M70.5	723	61.41169432
T03F6.3	723	61.41169432
Y18D10A.5	723	61.41169432
Y71F9AM.4	723	61.41169432
Y81B9A.1	722	61.32675421
Y54G9A.6	721	61.24181411
Y59A8A.1	721	61.24181411
C28C12.9	720	61.15687401

D2013.7	720	61.15687401
Y39A1A.14	720	61.15687401
T20H12.1	719	61.0719339
Y39A3CL.2	719	61.0719339
Y57A10A.2	719	61.0719339
F18E2.4	718	60.9869938
H27M09.1	718	60.9869938
T19B10.4	718	60.9869938
R02D3.4	717	60.9020537
R10E4.11	717	60.9020537
Y40B10A.1	716	60.8171136
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T13H2.5	715	60.73217349
Y59A8B.21	715	60.73217349
Y94H6A.11	715	60.73217349
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F44F4.3	714	60.64723339
Y110A7A.16	714	60.64723339
ZC434.7	714	60.64723339
C44B7.12	713	60.56229329
Y6D11A.1	713	60.56229329
F01F1.15	712	60.47735318
F36H1.6	712	60.47735318
F55H2.7	712	60.47735318
T26C12.1	712	60.47735318
Y37H2A.7	712	60.47735318
C33H5.19	711	60.39241308
Y73B3A.13	711	60.39241308
W02A11.5	710	60.30747298
Y42H9AR.4	710	60.30747298
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K11H12.1	709	60.22253288
R05H10.3	709	60.22253288
Y106G6D.7	709	60.22253288
Y45G5AL.1	709	60.22253288
Y48E1B.7	709	60.22253288
M176.2	708	60.13759277
R05G6.4	708	60.13759277
F54C9.1	707	60.05265267
F42G8.6	706	59.96771257
Y32H12A.8	706	59.96771257
Y34D9A.8	706	59.96771257
K10F12.6	705	59.88277247
F32H2.4	704	59.79783236
Y43F8C.14	704	59.79783236
C03E10.4	703	59.71289226
R01H10.1	703	59.71289226

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F52C9.7	702	59.62795216
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W07A8.3	702	59.62795216
C16A11.6	701	59.54301205
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Y47H9C.4	700	59.45807195
F36D4.5	699	59.37313185
R09B3.4	699	59.37313185
T10B11.8	699	59.37313185
C17E4.9	698	59.28819175
C36E8.3	698	59.28819175
W09H1.6	698	59.28819175
C25A1.8	697	59.20325164
W06H8.1	697	59.20325164
W09C3.4	697	59.20325164
Y62E10A.5	697	59.20325164
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R10E4.4	696	59.11831154
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VF11C1L.1	695	59.03337144
Y53C12B.2	695	59.03337144
Y54G11A.2	695	59.03337144
Y54G9A.7	695	59.03337144
Y97E10AR.3	695	59.03337144
C32F10.8	694	58.94843133
C36B1.5	694	58.94843133
C53A5.17	694	58.94843133
F58H7.5	694	58.94843133
W02D9.1	694	58.94843133
T26G10.4	693	58.86349123
W06E11.4	693	58.86349123
F13H8.10	692	58.77855113
C25G4.4	691	58.69361103
Y82E9BR.14	691	58.69361103
T28F12.3	690	58.60867092
F10G8.3	689	58.52373082
T07A9.10	689	58.52373082
Y73B6BL.19	689	58.52373082
B0024.13	688	58.43879072
Y24F12A.1	688	58.43879072
Y57G11C.3	687	58.35385062
F26E4.4	686	58.26891051
K08D9.3	686	58.26891051
T11G6.1	686	58.26891051
W03A5.6	686	58.26891051

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Y51H4A.3	684	58.09903031
Y54E10A.3	684	58.09903031
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C30A5.3	682	57.9291501
F14F11.1	682	57.9291501
K08E3.4	682	57.9291501
K11H3.8	682	57.9291501
W01G7.4	682	57.9291501
C06A6.4	681	57.84421
C24H11.6	681	57.84421
K03D10.3	681	57.84421
K03E5.3	681	57.84421
R10E12.1	681	57.84421
ZK1127.13	681	57.84421
ZK809.5	681	57.84421
F40F9.7	680	57.7592699
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Y50D4A.4	679	57.67432979
C10C6.5	678	57.58938969
F56D12.6	678	57.58938969
B0348.4	677	57.50444959
F59A3.6	677	57.50444959
Y50D4C.4	677	57.50444959
F23F1.5	676	57.41950948
F46F11.1	676	57.41950948
F57B9.1	676	57.41950948
C16C10.5	675	57.33456938
C41C4.7	675	57.33456938
Y67D2.1	675	57.33456938
B0205.6	674	57.24962928
R10E11.2	673	57.16468918
R186.7	673	57.16468918
Y39E4B.5	673	57.16468918
C15C6.3	672	57.07974907
R03D7.2	672	57.07974907
C56G2.1	671	56.99480897
R05D3.3	671	56.99480897
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ZK1098.7	671	56.99480897
C14A4.1	670	56.90986887
C14B1.9	670	56.90986887
K01G5.1	670	56.90986887
T26E3.4	670	56.90986887

F47D12.9	669	56.82492877
F59H6.11	669	56.82492877
Y105E8A.1	669	56.82492877
Y39B6A.14	669	56.82492877
F57B10.5	668	56.73998866
ZK370.5	668	56.73998866
F58D5.4	667	56.65504856
Y10G11A.1	667	56.65504856
F09E5.1	666	56.57010846
Y52B11A.9	666	56.57010846
C43E11.8	665	56.48516835
W02B12.13	665	56.48516835
W06H3.3	665	56.48516835
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Y48C3A.17	664	56.40022825
ZK688.9	664	56.40022825
K04G2.2	663	56.31528815
C15H11.7	662	56.23034805
F31D4.1	662	56.23034805
T26C11.7	662	56.23034805
B0035.8	661	56.14540794
M03A1.6	661	56.14540794
T16G12.3	661	56.14540794
T21B10.5	661	56.14540794
W02D7.7	661	56.14540794
Y102A5C.4	661	56.14540794
Y71F9AL.10	661	56.14540794
C09G12.8	660	56.06046784
K07B1.5	660	56.06046784
W10D9.4	660	56.06046784
D1046.1	659	55.97552774
K07B1.6	659	55.97552774
Y18D10A.11	659	55.97552774
Y50D7A.1	659	55.97552774
B0001.4	658	55.89058763
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F25H2.5	658	55.89058763
H37A05.4	658	55.89058763
F10E9.2	657	55.80564753
W02A11.4	657	55.80564753
Y67D2.3	657	55.80564753
M01D7.6	656	55.72070743
Y69A2AR.1	656	55.72070743
Y95B8A.4	656	55.72070743
F40D4.13	655	55.63576733
C15H11.8	654	55.55082722
F59E12.15	654	55.55082722
Y71G12B.24	654	55.55082722

W08E3.3	653	55.46588712
Y17G7B.2	653	55.46588712
Y87G2A.8	653	55.46588712
C34C12.5	652	55.38094702
C35D10.10	652	55.38094702
Y54G2A.18	652	55.38094702
Y5F2A.4	652	55.38094702
T28F4.4	651	55.29600691
W08G11.4	651	55.29600691
Y54G2A.29	651	55.29600691
Y65B4A.8	651	55.29600691
Y6D11A.2	651	55.29600691
W03A5.4	650	55.21106681
Y37D8A.14	650	55.21106681
Y47G6A.1	650	55.21106681
F49E8.5	649	55.12612671
ZK418.8	649	55.12612671
C01H6.7	648	55.04118661
C15H11.9	648	55.04118661
F54F2.5	648	55.04118661
C34C6.2	647	54.9562465
T09A5.9	647	54.9562465
T23G7.5	647	54.9562465
Y87G2A.18	647	54.9562465
C28A5.6	646	54.8713064
C35D10.16	646	54.8713064
F32A11.1	646	54.8713064
Y22D7AL.7	645	54.7863663
Y92H12BM.1	645	54.7863663
T01B11.3	644	54.7014262
ZK512.4	644	54.7014262
C56C10.9	643	54.61648609
D2023.6	643	54.61648609
T04A8.7	643	54.61648609
T21B10.1	643	54.61648609
Y38A10A.7	643	54.61648609
Y55H10A.1	643	54.61648609
Y71F9B.13	643	54.61648609
R07E5.8	642	54.53154599
W09D10.3	642	54.53154599
Y110A7A.14	642	54.53154599
F18A11.5	641	54.44660589
C28D4.3	640	54.36166578
C32E8.7	640	54.36166578
Y17G9B.5	640	54.36166578
Y53H1C.1	640	54.36166578
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ZK353.6	639	54.27672568
F56H9.4	638	54.19178558
K12H4.5	637	54.10684548
Y37E11AL.3	637	54.10684548
Y92H12BR.6	637	54.10684548
Y71F9AL.13	636	54.02190537
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F07B7.1	635	53.93696527
Y82E9BR.3	635	53.93696527
C28C12.12	634	53.85202517
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H20J04.6	633	53.76708506
T08B2.11	633	53.76708506
Y106G6H.15	633	53.76708506
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Y56A3A.1	632	53.68214496
Y75B8A.17	632	53.68214496
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Y104H12D.1	630	53.51226476
Y111B2A.10	630	53.51226476
Y48A5A.2	630	53.51226476
C24F3.1	629	53.42732465
H43I07.2	629	53.42732465
C17H12.1	628	53.34238455
F02E9.9	628	53.34238455
M70.4	628	53.34238455
Y51H7C.5	628	53.34238455
ZK177.8	628	53.34238455
F30A10.6	627	53.25744445
Y71H2B.2	627	53.25744445
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F32A11.2	625	53.08756424
F56D2.7	625	53.08756424
ZK1010.10	625	53.08756424
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Y71F9B.3	624	53.00262414
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Y63D3A.2	623	52.91768404
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F42G4.7	622	52.83274393
Y23H5A.2	622	52.83274393
Y57A10A.19	622	52.83274393
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Y59A8B.14	618	52.49298352
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F41E6.9	584	49.60502003
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T16G12.1	583	49.52007993
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Y66H1A.4	580	49.26525962
Y6D1A.2	580	49.26525962
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F45E12.5	578	49.09537941
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Y61A9LA.1	572	48.58573879
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T05H4.14	570	48.41585859
T24D1.4	570	48.41585859
Y41D4B.21	570	48.41585859
Y63D3A.9	570	48.41585859
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T05B11.3	569	48.33091849
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F57C2.1	566	48.07609818
Y59A8B.20	566	48.07609818
ZK863.6	566	48.07609818
Y37D8A.13	565	47.99115808
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ZK1128.6	565	47.99115808
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C14C10.2	564	47.90621797
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T07G12.10	564	47.90621797
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Y108G3AL.2	564	47.90621797
Y18H1A.3	564	47.90621797
F30F8.8	563	47.82127787
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C32H11.7	562	47.73633777
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Y37E3.5	562	47.73633777
Y67H2A.1	562	47.73633777
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T25G3.4	558	47.39657736
Y71F9AM.6	558	47.39657736
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Y57A10A.7	557	47.31163725
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Y17G9B.4	556	47.22669715
F13G3.9	555	47.14175705
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C37A5.9	544	46.20741592
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Y40B1A.3	543	46.12247581
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F26A3.1	532	45.18813468
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Y75B8A.31	532	45.18813468
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F46A9.5	508	43.14957222
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F13G3.6	506	42.97969201
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F43D2.1	506	42.97969201
K06H7.9	506	42.97969201
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W04A8.2	506	42.97969201
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W10G11.19	505	42.89475191
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Y48G8AL.11	502	42.6399316
Y53F4B.15	502	42.6399316
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Y57A10A.15	501	42.5549915
C01G10.8	500	42.47005139
F13E9.1	500	42.47005139
F35D11.5	500	42.47005139
C53D5.4	499	42.38511129
R02F2.1	499	42.38511129
Y62E10A.8	499	42.38511129
B0348.5	498	42.30017119
W09G3.1	498	42.30017119
Y37E3.10	498	42.30017119
Y66A7A.2	498	42.30017119
C25A1.13	497	42.21523109
C50F4.16	497	42.21523109
F21C3.5	497	42.21523109
F54C8.2	497	42.21523109
K02F2.2	497	42.21523109
T13H2.4	497	42.21523109
Y102A5C.36	497	42.21523109
R07E5.14	496	42.13029098
ZC395.10	496	42.13029098
F40D4.17	495	42.04535088
M7.1	495	42.04535088
C30A5.2	494	41.96041078
Y57A10A.29	494	41.96041078
C14A4.2	493	41.87547067
F58B3.4	493	41.87547067
C33F10.2	492	41.79053057
F39H2.5	492	41.79053057
F41C3.3	492	41.79053057
F59A2.5	492	41.79053057
C27B7.2	491	41.70559047
T16H12.13	491	41.70559047
ZK863.3	491	41.70559047
B0393.2	490	41.62065037
C14B9.7	490	41.62065037
C42C1.15	490	41.62065037
C50B6.3	490	41.62065037

F42H10.6	490	41.62065037
F54D5.2	490	41.62065037
Y119C1B.4	490	41.62065037
C33C12.8	489	41.53571026
C56A3.8	489	41.53571026
F32E10.5	489	41.53571026
F55A3.5	489	41.53571026
Y110A2AL.13	489	41.53571026
Y92H12A.2	489	41.53571026
ZK1098.4	489	41.53571026
C01A2.1	488	41.45077016
C24D10.4	488	41.45077016
R06B9.6	488	41.45077016
Y119D3B.12	488	41.45077016
C10G11.5	487	41.36583006
Y54E10BL.5	487	41.36583006
ZK402.3	487	41.36583006
C07G1.4	486	41.28088995
F08B6.2	486	41.28088995
F13G3.11	486	41.28088995
W02D7.6	486	41.28088995
Y17G9B.3	486	41.28088995
W09D6.1	485	41.19594985
B0334.4	484	41.11100975
Y38H6C.5	484	41.11100975
Y56A3A.12	484	41.11100975
ZK430.2	484	41.11100975
Y39B6A.46	482	40.94112954
F29F11.6	481	40.85618944
F33H2.3	481	40.85618944
F56F3.5	481	40.85618944
Y41D4A.3	481	40.85618944
ZK973.11	481	40.85618944
C41D11.4	480	40.77124934
ZK892.6	480	40.77124934
F33H2.6	479	40.68630924
Y60A3A.14	479	40.68630924
ZK1320.11	479	40.68630924
C04H5.1	478	40.60136913
C05C10.5	478	40.60136913
T06E6.2	478	40.60136913
C24H11.9	477	40.51642903
JC8.2	477	40.51642903
Y37B11A.2	477	40.51642903
Y75B8A.16	477	40.51642903
T22A3.5	476	40.43148893
Y108F1.4	476	40.43148893
Y20F4.8	476	40.43148893

Y54E5A.2	476	40.43148893
W03C9.3	475	40.34654882
Y44F5A.1	475	40.34654882
D1054.2	474	40.26160872
M01B12.3	474	40.26160872
T20G5.10	474	40.26160872
Y53H1A.1	473	40.17666862
B0001.1	472	40.09172852
F47B7.6	472	40.09172852
T10B11.6	472	40.09172852
T12B3.4	472	40.09172852
B0393.6	471	40.00678841
C47B2.2	471	40.00678841
C49F5.6	471	40.00678841
F44G4.4	471	40.00678841
K10D2.8	471	40.00678841
T06D8.5	471	40.00678841
F40F8.3	470	39.92184831
C54G10.2	469	39.83690821
F26H9.7	469	39.83690821
K03B4.3	469	39.83690821
Y37D8A.17	469	39.83690821
Y41C4A.4	469	39.83690821
C38C10.2	468	39.7519681
C41D11.6	468	39.7519681
C54C6.6	468	39.7519681
C56C10.8	468	39.7519681
F10E7.7	468	39.7519681
F49B2.3	467	39.667028
M01E11.7	467	39.667028
T22F3.12	467	39.667028
Y57A10A.30	467	39.667028
C06B8.8	466	39.5820879
C08B6.8	466	39.5820879
F54A3.6	466	39.5820879
R04F11.3	466	39.5820879
Y48G1A.2	466	39.5820879
ZC123.4	466	39.5820879
T06D8.7	465	39.4971478
Y46G5A.13	465	39.4971478
C47B2.1	464	39.41220769
F37C12.2	464	39.41220769
F52B10.1	464	39.41220769
F58F12.1	464	39.41220769
T07F8.4	464	39.41220769
Y77E11A.1	464	39.41220769
K10D2.2	463	39.32726759
F41C3.4	462	39.24232749

F56E10.1	462	39.24232749
C28D4.2	461	39.15738739
E02H9.2	461	39.15738739
F25H2.10	461	39.15738739
H14E04.5	461	39.15738739
T27E9.2	461	39.15738739
Y43F4A.3	461	39.15738739
Y53F4B.18	461	39.15738739
Y54E10A.12	461	39.15738739
C06H2.6	460	39.07244728
F32B6.3	460	39.07244728
Y113G7B.16	460	39.07244728
Y71G12B.11	460	39.07244728
C03C10.3	459	38.98750718
C04C3.3	459	38.98750718
E04F6.5	459	38.98750718
F10G8.9	459	38.98750718
F33E11.6	459	38.98750718
T23B12.6	459	38.98750718
Y45G12C.16	459	38.98750718
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F25B5.7	458	38.90256708
T23B12.1	458	38.90256708
Y38H8A.7	458	38.90256708
Y75D11A.1	458	38.90256708
ZK550.5	458	38.90256708
C16C2.4	457	38.81762697
F55C9.3	457	38.81762697
K02D10.5	457	38.81762697
Y102A5C.18	457	38.81762697
Y48C3A.18	457	38.81762697
Y73F8A.24	457	38.81762697
C09G9.2	456	38.73268687
C53A5.13	456	38.73268687
Y45F10A.3	456	38.73268687
ZK402.1	456	38.73268687
C09G4.4	455	38.64774677
K08E4.7	455	38.64774677
Y53H1A.5	455	38.64774677
C33H5.7	454	38.56280667
K08A2.4	454	38.56280667
Y45G12B.3	454	38.56280667
Y73B6BL.4	454	38.56280667
C52E12.3	453	38.47786656
F48A11.5	453	38.47786656
T15H9.7	453	38.47786656
Y50E8A.4	453	38.47786656

C06C3.8	452	38.39292646
F35B12.5	452	38.39292646
VH15N14R.1	452	38.39292646
Y71H2AL.1	452	38.39292646
B0238.11	451	38.30798636
C52B11.2	451	38.30798636
T05G5.7	451	38.30798636
VB0393L.2	451	38.30798636
Y110A7A.11	451	38.30798636
C36A4.4	450	38.22304625
F37D6.2	450	38.22304625
R13.4	450	38.22304625
W03C9.2	450	38.22304625
F18A1.8	448	38.05316605
F36H9.3	448	38.05316605
F56H11.4	448	38.05316605
Y45F10A.4	448	38.05316605
B0336.6	447	37.96822595
R144.10	447	37.96822595
T14G8.3	447	37.96822595
Y105E8A.7	447	37.96822595
Y41C4A.12	447	37.96822595
C15C6.4	446	37.88328584
F32D8.4	446	37.88328584
F33E11.2	446	37.88328584
T23G11.4	446	37.88328584
Y39B6A.16	446	37.88328584
Y73F8A.26	446	37.88328584
C25G4.3	445	37.79834574
T04A8.10	445	37.79834574
Y43F4B.9	445	37.79834574
C08B11.2	444	37.71340564
F53H2.3	443	37.62846554
H14A12.5	443	37.62846554
Y38F2AL.3	443	37.62846554
F55C5.5	442	37.54352543
F56C9.11	442	37.54352543
Y71F9B.6	442	37.54352543
C14C10.6	441	37.45858533
C52E12.2	441	37.45858533
F53A2.6	441	37.45858533
Y39B6A.12	441	37.45858533
B0546.3	440	37.37364523
Y47G6A.31	440	37.37364523
Y51H1A.5	440	37.37364523
C18E3.8	439	37.28870512
K02E2.6	439	37.28870512
T26A5.8	439	37.28870512

Y47D3A.17	439	37.28870512
Y55D9A.2	439	37.28870512
C09E7.9	438	37.20376502
C30B5.2	438	37.20376502
C32E8.5	438	37.20376502
T10E9.2	438	37.20376502
ZK662.3	438	37.20376502
AC8.4	437	37.11882492
C53A5.16	437	37.11882492
D1054.14	437	37.11882492
F18E9.5	436	37.03388482
T13H5.4	436	37.03388482
T26A5.9	436	37.03388482
Y37E11B.6	436	37.03388482
ZK632.2	436	37.03388482
ZK863.7	436	37.03388482
C06G3.10	435	36.94894471
C16C8.5	435	36.94894471
F01D4.4	435	36.94894471
F32A5.7	435	36.94894471
W05F2.4	435	36.94894471
Y51H7C.7	435	36.94894471
F12F6.5	434	36.86400461
R02C2.4	434	36.86400461
R04E5.9	434	36.86400461
Y44A6D.3	434	36.86400461
Y48G1BM.7	434	36.86400461
ZK652.10	434	36.86400461
B0334.8	433	36.77906451
F54C9.6	433	36.77906451
K12H4.2	433	36.77906451
R11D1.1	433	36.77906451
T16G12.8	433	36.77906451
ZC434.4	433	36.77906451
C06A8.4	432	36.6941244
C33C12.11	432	36.6941244
F26F4.8	431	36.6091843
Y47D3A.23	431	36.6091843
F12F6.3	430	36.5242442
F28C6.7	430	36.5242442
F39H2.3	430	36.5242442
F54E4.1	430	36.5242442
Y106G6H.8	430	36.5242442
Y55F3AR.1	430	36.5242442
Y60A3A.8	430	36.5242442
ZK1005.1	430	36.5242442
C27H6.1	429	36.4393041
Y48A6B.5	429	36.4393041

C44B7.10	428	36.35436399
T04D1.2	428	36.35436399
T20B12.2	428	36.35436399
T20G5.9	428	36.35436399
Y47H10A.1	428	36.35436399
Y59A8A.3	428	36.35436399
C37A5.1	427	36.26942389
D2024.3	427	36.26942389
T23D8.3	427	36.26942389
Y116A8C.34	427	36.26942389
Y55F3BR.4	427	36.26942389
Y71H2AR.1	427	36.26942389
ZC434.2	427	36.26942389
R144.5	426	36.18448379
T07E3.5	426	36.18448379
W09D6.6	426	36.18448379
Y106G6E.5	426	36.18448379
Y45F10D.9	426	36.18448379
F09G2.8	425	36.09954368
F21H12.4	425	36.09954368
H35N09.2	425	36.09954368
Y11D7A.10	425	36.09954368
Y73B3A.3	425	36.09954368
Y75B12B.4	425	36.09954368
ZK1127.1	425	36.09954368
F26H11.1	424	36.01460358
F57A10.2	424	36.01460358
T22H9.1	423	35.92966348
Y55F3AM.6	423	35.92966348
Y63D3A.8	423	35.92966348
C48E7.3	422	35.84472338
F33D11.11	422	35.84472338
K10C8.3	422	35.84472338
T27F6.7	422	35.84472338
C14A4.14	421	35.75978327
F08F8.8	421	35.75978327
F13G3.4	421	35.75978327
F35H10.6	421	35.75978327
F45H7.6	421	35.75978327
Y54G11A.13	421	35.75978327
Y66D12A.3	421	35.75978327
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T02C12.2	420	35.67484317
F33G12.2	419	35.58990307
K10B3.5	419	35.58990307
T24G10.2	419	35.58990307
Y54G11A.1	419	35.58990307
C05D10.2	418	35.50496297

F13H8.8	418	35.50496297
F30A10.3	418	35.50496297
F56C11.5	418	35.50496297
R10F2.1	418	35.50496297
Y48A6C.4	418	35.50496297
C32D5.12	417	35.42002286
R186.8	417	35.42002286
Y94H6A.7	417	35.42002286
T10B10.3	416	35.33508276
Y50D7A.5	416	35.33508276
C27A12.7	415	35.25014266
Y62E10A.15	415	35.25014266
ZK652.1	415	35.25014266
C47B2.7	414	35.16520255
T03D8.2	414	35.16520255
T06D10.2	414	35.16520255
T24H10.3	414	35.16520255
Y54G2A.12	414	35.16520255
Y56A3A.22	414	35.16520255
C27B7.8	413	35.08026245
CD4.6	412	34.99532235
E04A4.7	412	34.99532235
M01F1.1	412	34.99532235
Y53G8B.3	412	34.99532235
Y54E10BR.8	412	34.99532235
ZK1307.5	412	34.99532235
ZK1320.7	412	34.99532235
F08B4.6	411	34.91038225
F44B9.4	411	34.91038225
Y71H2AM.20	411	34.91038225
F20D1.3	410	34.82544214
F29C4.6	410	34.82544214
K07A1.9	410	34.82544214
D2030.1	409	34.74050204
F55B11.6	409	34.74050204
Y60A3A.19	409	34.74050204
Y76B12C.3	409	34.74050204
C43E11.12	408	34.65556194
K02B2.3	408	34.65556194
Y37E11AL.1	408	34.65556194
C29E4.5	407	34.57062183
F33D11.10	407	34.57062183
Y48A5A.3	407	34.57062183
Y76A2B.2	407	34.57062183
B0361.8	406	34.48568173
C34C12.9	406	34.48568173
F09G8.3	406	34.48568173
F57C7.1	406	34.48568173

T15H9.2	406	34.48568173
F15D4.2	404	34.31580153
T19C3.6	404	34.31580153
Y37A1B.17	404	34.31580153
Y54E10BR.5	404	34.31580153
F49E8.4	403	34.23086142
K09B11.1	403	34.23086142
W06B11.2	403	34.23086142
Y17G7B.10	403	34.23086142
B0205.7	402	34.14592132
C35D10.4	402	34.14592132
C56A3.6	402	34.14592132
F36H12.2	402	34.14592132
VF13D12L.3	402	34.14592132
Y62F5A.9	402	34.14592132
B0304.4	401	34.06098122
C50B6.2	401	34.06098122
D2085.1	401	34.06098122
Y41D4A.5	401	34.06098122
Y45G5AM.9	400	33.97604112
C02F5.10	399	33.89110101
C08B6.9	399	33.89110101
C07G3.8	397	33.72122081
F26F4.3	397	33.72122081
Y39A3CL.4	397	33.72122081
C01G10.12	396	33.6362807
E01G4.1	396	33.6362807
F25H9.6	396	33.6362807
F54F2.8	396	33.6362807
K02B12.5	396	33.6362807
Y39A3CR.7	396	33.6362807
K08H10.4	395	33.5513406
Y23H5A.4	395	33.5513406
C42C1.8	394	33.4664005
E01A2.1	394	33.4664005
F59B2.7	394	33.4664005
Y17G7B.4	394	33.4664005
F26A1.1	393	33.3814604
H43I07.3	393	33.3814604
F26D11.1	392	33.29652029
F29G9.3	392	33.29652029
F54C4.4	392	33.29652029
T05G5.9	392	33.29652029
Y54F10AR.1	392	33.29652029
C17E4.11	391	33.21158019
R12E2.11	391	33.21158019
ZK673.2	391	33.21158019
D2013.10	390	33.12664009

F35C11.5	390	33.12664009
F36A2.6	390	33.12664009
F44B9.5	390	33.12664009
F46E10.9	390	33.12664009
W02B12.10	390	33.12664009
Y46G5A.12	390	33.12664009
Y77E11A.2	390	33.12664009
C07D8.6	389	33.04169998
F56A8.1	389	33.04169998
T04D1.4	389	33.04169998
Y73F8A.32	389	33.04169998
C30H7.2	388	32.95675988
Y106G6E.6	388	32.95675988
C17F4.5	387	32.87181978
F37C12.4	387	32.87181978
K02C4.4	387	32.87181978
M04G12.4	387	32.87181978
R148.4	387	32.87181978
T16H12.4	387	32.87181978
Y39G10AR.20	387	32.87181978
ZK185.1	387	32.87181978
D1014.3	386	32.78687968
F22H10.5	386	32.78687968
R02F2.4	386	32.78687968
C08B11.7	385	32.70193957
F20D12.5	385	32.70193957
F29F11.3	385	32.70193957
Y110A7A.12	385	32.70193957
C44B9.3	384	32.61699947
F45H10.2	384	32.61699947
JC8.3	384	32.61699947
T24H10.4	384	32.61699947
Y17G7B.7	384	32.61699947
Y46H3C.7	384	32.61699947
F15D3.1	383	32.53205937
F15D4.4	383	32.53205937
F26D2.2	383	32.53205937
F42A8.2	383	32.53205937
K06H7.4	383	32.53205937
B0244.2	382	32.44711926
C01G6.4	382	32.44711926
C34B2.10	382	32.44711926
E02H1.3	382	32.44711926
EEED8.3	382	32.44711926
M01F1.5	382	32.44711926
T04H1.6	382	32.44711926
Y49F6C.5	382	32.44711926
C34C12.8	381	32.36217916

F27D4.7	381	32.36217916
F53G12.5	381	32.36217916
T20D3.7	381	32.36217916
W09G3.3	381	32.36217916
Y106G6H.6	381	32.36217916
Y47H9C.9	381	32.36217916
R06C1.3	380	32.27723906
C02E11.1	379	32.19229896
C04B4.2	379	32.19229896
F33H1.3	379	32.19229896
F55G1.11	379	32.19229896
K09E4.3	379	32.19229896
Y56A3A.30	379	32.19229896
C09E7.4	378	32.10735885
C41D11.5	378	32.10735885
F52E1.10	378	32.10735885
K02B2.5	378	32.10735885
Y56A3A.4	378	32.10735885
AC8.11	377	32.02241875
M02F4.1	377	32.02241875
T02H6.11	377	32.02241875
F57C2.2	376	31.93747865
R06B9.3	376	31.93747865
Y18D10A.20	376	31.93747865
Y54H5A.2	376	31.93747865
ZK418.7	376	31.93747865
C06A5.8	375	31.85253855
B0334.3	374	31.76759844
B0491.7	374	31.76759844
C29E4.13	373	31.68265834
C33H5.15	373	31.68265834
F40A3.3	373	31.68265834
Y104H12BR.1	373	31.68265834
Y119D3B.15	373	31.68265834
Y43E12A.1	373	31.68265834
C24G6.1	372	31.59771824
ZK686.4	372	31.59771824
K03H6.5	371	31.51277813
Y43B11AR.3	371	31.51277813
B0019.2	370	31.42783803
F26D10.10	370	31.42783803
F52H3.2	370	31.42783803
Y66H1B.4	370	31.42783803
K07A1.8	369	31.34289793
T23G11.7	369	31.34289793
D2030.3	368	31.25795783
F09E5.8	368	31.25795783
T02C1.1	368	31.25795783

W02D9.2	368	31.25795783
Y37D8A.21	368	31.25795783
C24F3.5	367	31.17301772
F26A1.13	367	31.17301772
F29B9.4	367	31.17301772
F57C9.3	367	31.17301772
K08H2.1	367	31.17301772
T19A6.3	367	31.17301772
Y50C1A.1	367	31.17301772
C34B7.4	366	31.08807762
K07B1.7	366	31.08807762
Y55F3AM.21	366	31.08807762
Y71F9B.16	366	31.08807762
W10D9.6	365	31.00313752
B0035.14	364	30.91819741
C06G3.8	364	30.91819741
C37A2.7	364	30.91819741
F33D4.1	364	30.91819741
F40G9.1	363	30.83325731
K11D2.1	363	30.83325731
D1046.3	362	30.74831721
F14E5.8	362	30.74831721
F52C9.1	362	30.74831721
F54D8.6	362	30.74831721
F59G1.1	362	30.74831721
R119.3	362	30.74831721
W04B5.1	362	30.74831721
Y87G2A.14	362	30.74831721
F26E4.6	361	30.66337711
T07F10.3	361	30.66337711
W05F2.3	361	30.66337711
Y49A3A.3	361	30.66337711
ZC15.3	361	30.66337711
F30B5.4	360	30.578437
H17B01.1	360	30.578437
T13F2.1	360	30.578437
Y25C1A.8	360	30.578437
F21F3.4	359	30.4934969
F46B6.12	359	30.4934969
C55B6.2	358	30.4085568
F26A3.2	358	30.4085568
JC8.7	358	30.4085568
F43G9.4	357	30.3236167
M04B2.3	357	30.3236167
Y105E8A.2	357	30.3236167
Y79H2A.4	357	30.3236167
CC4.3	356	30.23867659
Y49E10.14	356	30.23867659

ZK669.4	356	30.23867659
K03B4.7	355	30.15373649
W06E11.2	355	30.15373649
F35G12.4	354	30.06879639
F54B3.3	354	30.06879639
Y39A1A.23	354	30.06879639
Y54E5B.3	354	30.06879639
ZK418.5	354	30.06879639
C34G6.5	353	29.98385628
F35H12.2	353	29.98385628
F56A8.4	353	29.98385628
W03F9.5	353	29.98385628
C50F4.13	352	29.89891618
F37C12.1	352	29.89891618
F59A3.5	352	29.89891618
Y67D2.6	352	29.89891618
ZK154.7	352	29.89891618
C54C6.2	351	29.81397608
F39B2.5	351	29.81397608
F54E7.9	351	29.81397608
R12B2.4	351	29.81397608
C05D11.12	350	29.72903598
M163.4	350	29.72903598
Y57A10A.28	350	29.72903598
F48E8.4	349	29.64409587
W04B5.2	349	29.64409587
Y36E3A.2	349	29.64409587
Y37F4.6	349	29.64409587
C54G4.8	348	29.55915577
F54D10.4	348	29.55915577
T16H12.2	348	29.55915577
T26A5.4	348	29.55915577
Y38F2AR.1	348	29.55915577
Y48E1B.2	348	29.55915577
ZC434.6	348	29.55915577
C55A6.10	347	29.47421567
E02H1.6	347	29.47421567
F49E8.7	347	29.47421567
R10F2.6	347	29.47421567
Y111B2A.12	347	29.47421567
C34B2.7	346	29.38927556
C34C12.1	346	29.38927556
F53F4.4	346	29.38927556
K06H7.3	346	29.38927556
T04A8.6	346	29.38927556
Y56A3A.31	346	29.38927556
Y71H2AM.4	346	29.38927556
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F09F7.7	345	29.30433546
F54D5.11	345	29.30433546
R02D5.8	345	29.30433546
T10B11.1	345	29.30433546
W10D9.3	345	29.30433546
C53A5.1	344	29.21939536
F26H9.4	344	29.21939536
F47D12.4	344	29.21939536
Y110A2AL.1	344	29.21939536
Y37E3.7	344	29.21939536
F11A6.2	343	29.13445526
T05A12.4	343	29.13445526
T07E3.2	343	29.13445526
T22D1.10	343	29.13445526
Y39B6A.34	343	29.13445526
ZC155.4	343	29.13445526
F46F11.5	342	29.04951515
F53F1.2	342	29.04951515
W09G3.7	342	29.04951515
ZK131.5	342	29.04951515
B0041.8	341	28.96457505
B0361.10	341	28.96457505
C45G3.5	341	28.96457505
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B0379.4	340	28.87963495
D2096.7	340	28.87963495
F46B6.3	340	28.87963495
F55F8.4	340	28.87963495
M18.3	340	28.87963495
C34E10.11	339	28.79469485
F08G12.2	339	28.79469485
K06H7.6	339	28.79469485
Y47D3B.11	339	28.79469485
C49A9.4	338	28.70975474
F54C8.5	338	28.70975474
K07B1.4	338	28.70975474
T22A3.8	338	28.70975474
C16C10.2	337	28.62481464
F01F1.2	337	28.62481464
F09G2.1	337	28.62481464
F39B2.8	337	28.62481464
K09E3.2	337	28.62481464
Y39E4B.12	337	28.62481464
Y50D7A.2	337	28.62481464
F39B2.6	336	28.53987454
K01A11.3	336	28.53987454
T07A5.5	336	28.53987454
T21C9.4	336	28.53987454

F07F6.7	335	28.45493443
F31E9.6	335	28.45493443
M02D8.3	335	28.45493443
M142.6	335	28.45493443
T21C9.13	335	28.45493443
Y54E10BL.4	335	28.45493443
C24H12.2	334	28.36999433
C01G10.10	333	28.28505423
C41G7.1	333	28.28505423
D1069.3	333	28.28505423
F21D5.7	333	28.28505423
W08F4.6	333	28.28505423
Y54E10A.7	333	28.28505423
C35D10.17	332	28.20011413
T07A9.8	332	28.20011413
W02F12.6	332	28.20011413
C16C8.13	331	28.11517402
F25H2.12	331	28.11517402
F26H9.2	331	28.11517402
T24H7.4	331	28.11517402
Y17G7B.12	331	28.11517402
Y55F3AM.7	331	28.11517402
C18D1.1	330	28.03023392
C25H3.7	330	28.03023392
F15C11.2	330	28.03023392
F49C12.9	330	28.03023392
H20J04.9	330	28.03023392
M142.8	330	28.03023392
T25D3.2	330	28.03023392
C14B9.2	329	27.94529382
M88.4	329	27.94529382
R74.6	329	27.94529382
T20B12.7	329	27.94529382
ZK783.2	329	27.94529382
C50F4.7	328	27.86035371
F20D1.6	328	27.86035371
F21F3.7	328	27.86035371
T20H4.5	328	27.86035371
Y38F2AR.9	328	27.86035371
C33H5.10	327	27.77541361
C50C3.7	327	27.77541361
T12B5.11	327	27.77541361
Y37H2A.6	327	27.77541361
ZK287.5	327	27.77541361
F22D6.9	326	27.69047351
T12F5.4	326	27.69047351
T24H7.3	326	27.69047351
T27C10.3	326	27.69047351

Y106G6A.1	326	27.69047351
Y39G10AR.6	326	27.69047351
Y46G5A.19	326	27.69047351
Y48A6B.8	326	27.69047351
Y65B4BL.5	326	27.69047351
F54E7.1	325	27.60553341
Y53F4B.16	325	27.60553341
Y57G11C.34	325	27.60553341
ZK652.4	325	27.60553341
C04A2.1	324	27.5205933
M01E5.2	324	27.5205933
Y57E12AM.1	324	27.5205933
C50C3.8	323	27.4356532
F26D10.9	323	27.4356532
F26F4.4	323	27.4356532
T05A12.2	323	27.4356532
C01F1.6	322	27.3507131
F22B5.10	322	27.3507131
F56H9.5	322	27.3507131
Y18D10A.16	322	27.3507131
C14B1.3	321	27.26577299
C18D11.3	321	27.26577299
Y53C10A.6	321	27.26577299
B0511.9	320	27.18083289
F13B9.1	320	27.18083289
F26A3.4	320	27.18083289
R12B2.2	320	27.18083289
T09A5.6	320	27.18083289
T25B9.9	320	27.18083289
Y56A3A.7	320	27.18083289
ZK909.3	320	27.18083289
C53D5.1	319	27.09589279
F54D5.1	319	27.09589279
Y119D3B.22	319	27.09589279
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F36H1.1	318	27.01095269
F52C6.11	318	27.01095269
M01E11.1	318	27.01095269
T05H10.2	318	27.01095269
Y38H6C.11	318	27.01095269
C15C7.2	317	26.92601258
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F42G9.5	316	26.84107248
ZC123.1	316	26.84107248
ZK131.9	316	26.84107248
ZK836.2	316	26.84107248
F44E5.1	315	26.75613238

H20J04.3	315	26.75613238
R74.3	315	26.75613238
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T22C1.5	315	26.75613238
Y50D4C.6	315	26.75613238
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C08B11.5	314	26.67119228
C27F2.9	314	26.67119228
F01D4.5	314	26.67119228
F18A1.7	314	26.67119228
F53B6.4	314	26.67119228
ZK328.4	314	26.67119228
F02C12.3	313	26.58625217
F11A10.8	313	26.58625217
F47G3.2	313	26.58625217
F49E7.1	313	26.58625217
F57B9.3	313	26.58625217
ZK682.2	313	26.58625217
F22D6.10	312	26.50131207
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M05D6.2	312	26.50131207
R04F11.5	312	26.50131207
C45H4.14	311	26.41637197
F54D12.6	311	26.41637197
R10E4.1	311	26.41637197
R11D1.10	311	26.41637197
T01G9.6	311	26.41637197
Y71G10AR.4	311	26.41637197
C03H5.3	310	26.33143186
C46A5.4	310	26.33143186
F01D5.10	310	26.33143186
F32B5.6	310	26.33143186
F45E6.2	310	26.33143186
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C18E9.11	309	26.24649176
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T08G11.4	309	26.24649176
T12A2.8	309	26.24649176
ZK1073.1	309	26.24649176
B0393.8	308	26.16155166
C10H11.8	308	26.16155166
F40G9.4	308	26.16155166
ZK858.3	308	26.16155166
C11D2.7	307	26.07661156
C26B2.6	307	26.07661156

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R08A2.7	307	26.07661156
R10E11.4	307	26.07661156
T16G1.11	307	26.07661156
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Y47G6A.14	307	26.07661156
Y48G8AL.8	307	26.07661156
F10D11.1	306	25.99167145
F32H2.2	306	25.99167145
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ZK829.6	306	25.99167145
C29F9.1	305	25.90673135
C52A11.4	305	25.90673135
F43G9.13	305	25.90673135
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F44E2.3	303	25.73685114
F52C6.8	303	25.73685114
K02B12.7	303	25.73685114
F28D1.7	302	25.65191104
F45E4.3	302	25.65191104
F56B3.8	302	25.65191104
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Y113G7B.3	302	25.65191104
F20D1.4	301	25.56697094
T10B11.5	301	25.56697094
ZK20.4	301	25.56697094
C08H9.16	300	25.48203084
C37A5.7	300	25.48203084
F27D4.1	300	25.48203084
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Y48G1A.1	300	25.48203084
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W02C12.3	299	25.39709073
Y40B1A.1	299	25.39709073
Y53G8AR.6	299	25.39709073

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F29G9.1	298	25.31215063
F52E10.1	298	25.31215063
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Y69A2AR.21	298	25.31215063
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F37C12.3	296	25.14227043
F40F8.10	296	25.14227043
Y56A3A.15	296	25.14227043
Y59A8B.12	296	25.14227043
ZK1236.3	296	25.14227043
F10B5.5	295	25.05733032
F58A4.14	295	25.05733032
Y53C12A.11	295	25.05733032
Y54G2A.50	295	25.05733032
Y92C3B.3	295	25.05733032
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