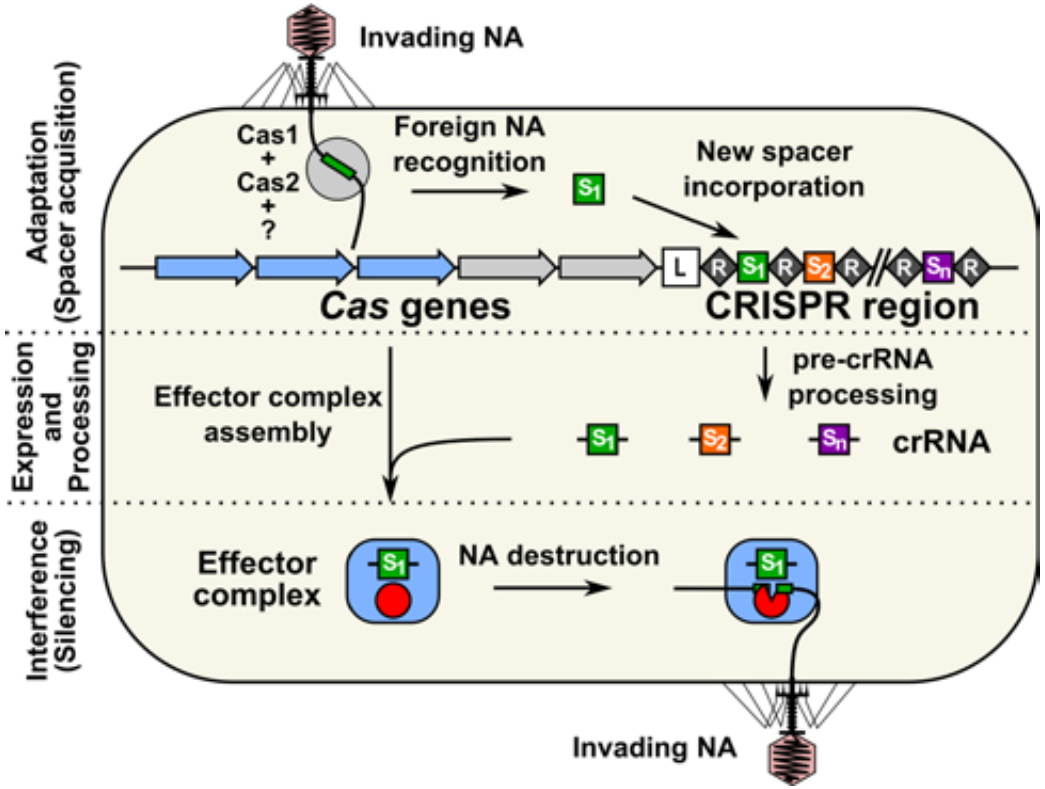
The CRISPR/Cas system is a bacterial immune mechanism vs “viruses”



CRISPR = Clustered Regularly Interspaced Short Palindromic Repeats

CAS = CRISPR associated genes (nucleases and DNA binding proteins)

These regions of the bacterial genome are the “memory” of an immune system that recognizes and destroys invading DNA from a bacteriophage/virus. The “spacers” are pieces of phage DNA that direct a nuclease (CAS protein) to invading DNA sequences.

Cell. Mol. Life Sci. (2014) 71:449–465

CRISPR-Cas9 can cause deletions/insertions to knock out a gene (A)

OR

can introduce a new sequence to replace or mutate a gene (B)

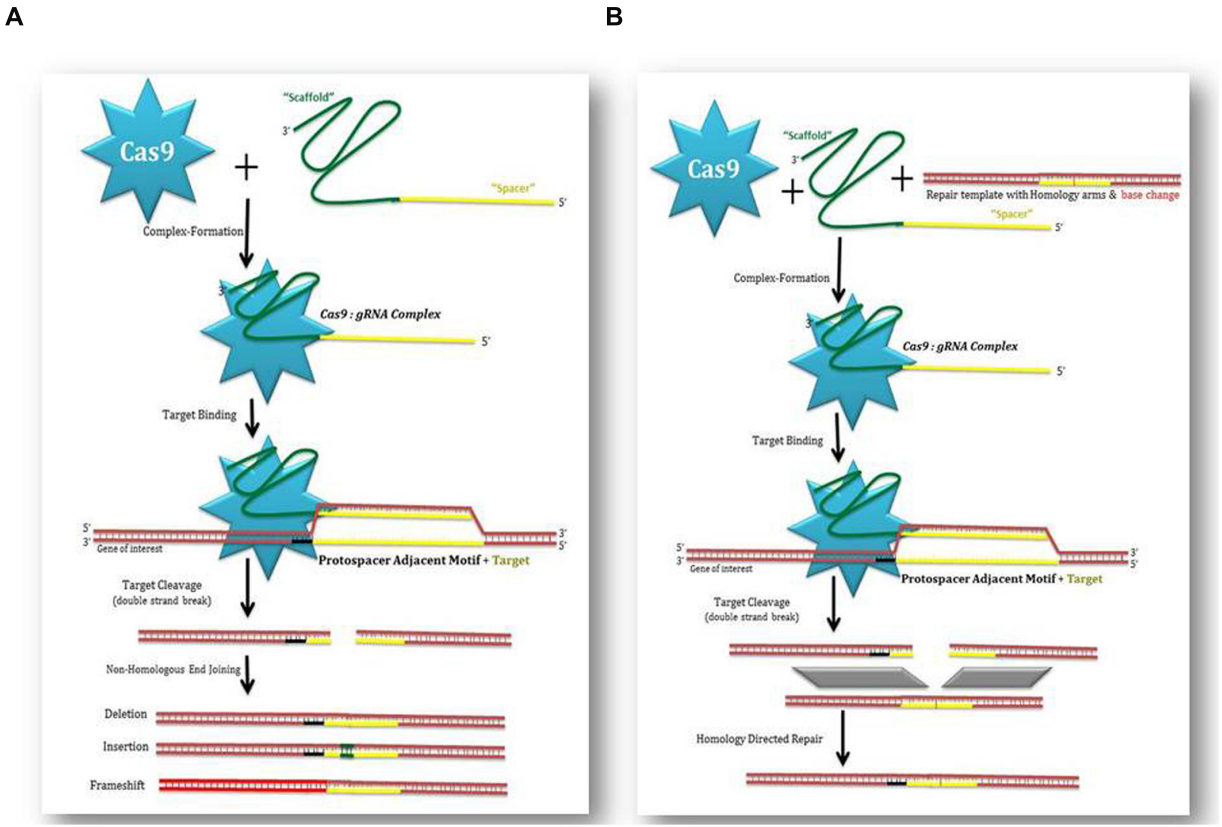


FIGURE 2 | How CRISPR-Cas9 perform genome editing. Cas9 induce double stranded breaks (DSBs) at particular site. The resulting DSB is then repaired by one of these two general repair pathways, e.g., by Non-homologous end joining (NHEJ) or by Homology directed repair (HDR). **(A)** The NHEJ repair pathway frequently results in small nucleotide insertions or deletions (InDels) at the DSB site. This may result in gene knock out or gene insertion. **(B)** HDR can be used to generate precise nucleotide modifications (also called gene "edits") ranging from a single nucleotide change to large insertions.

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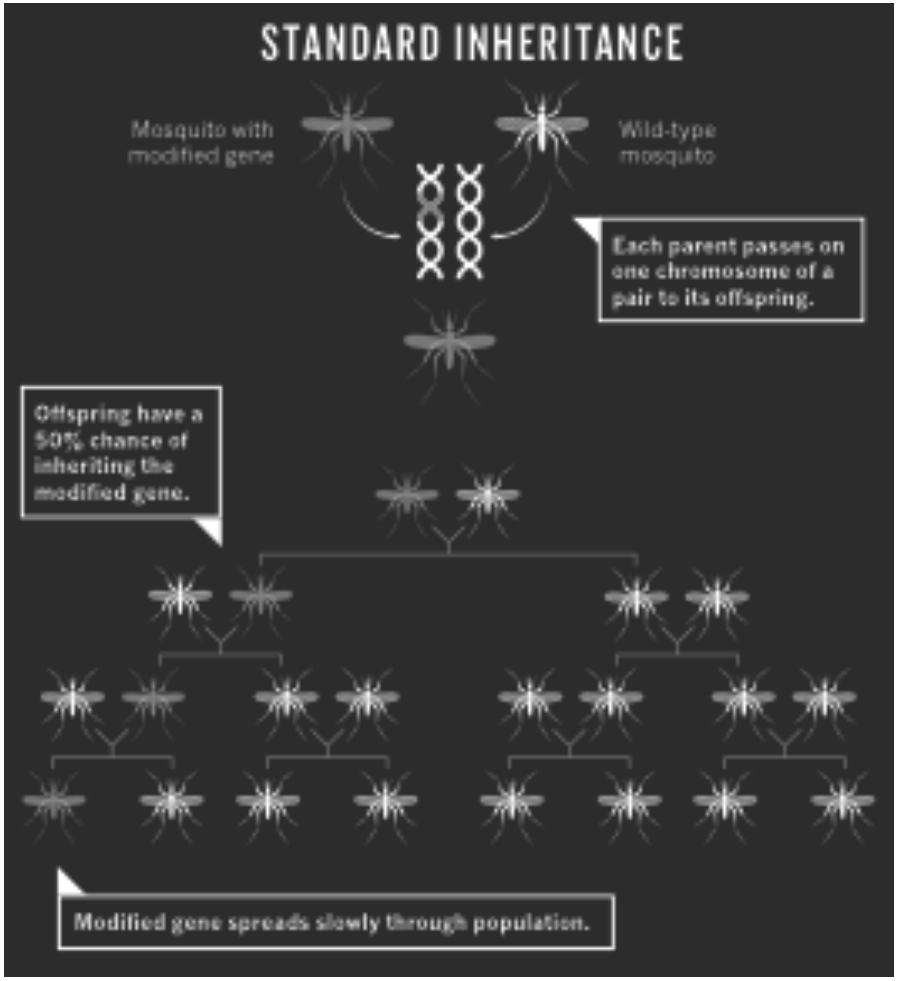
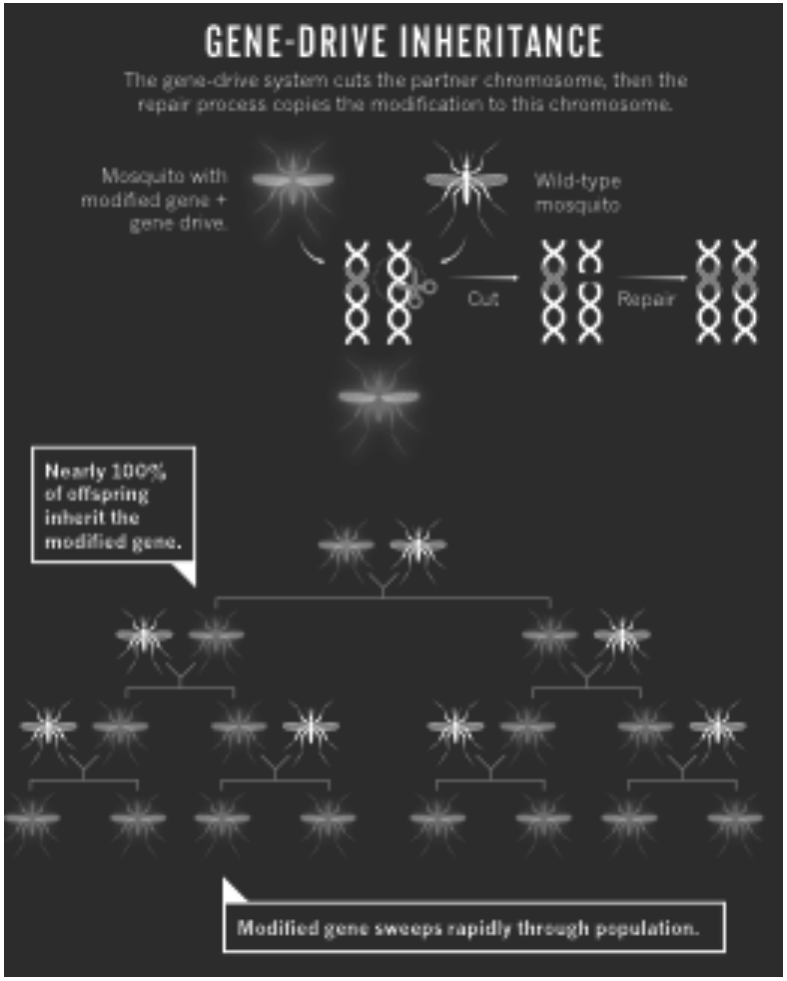
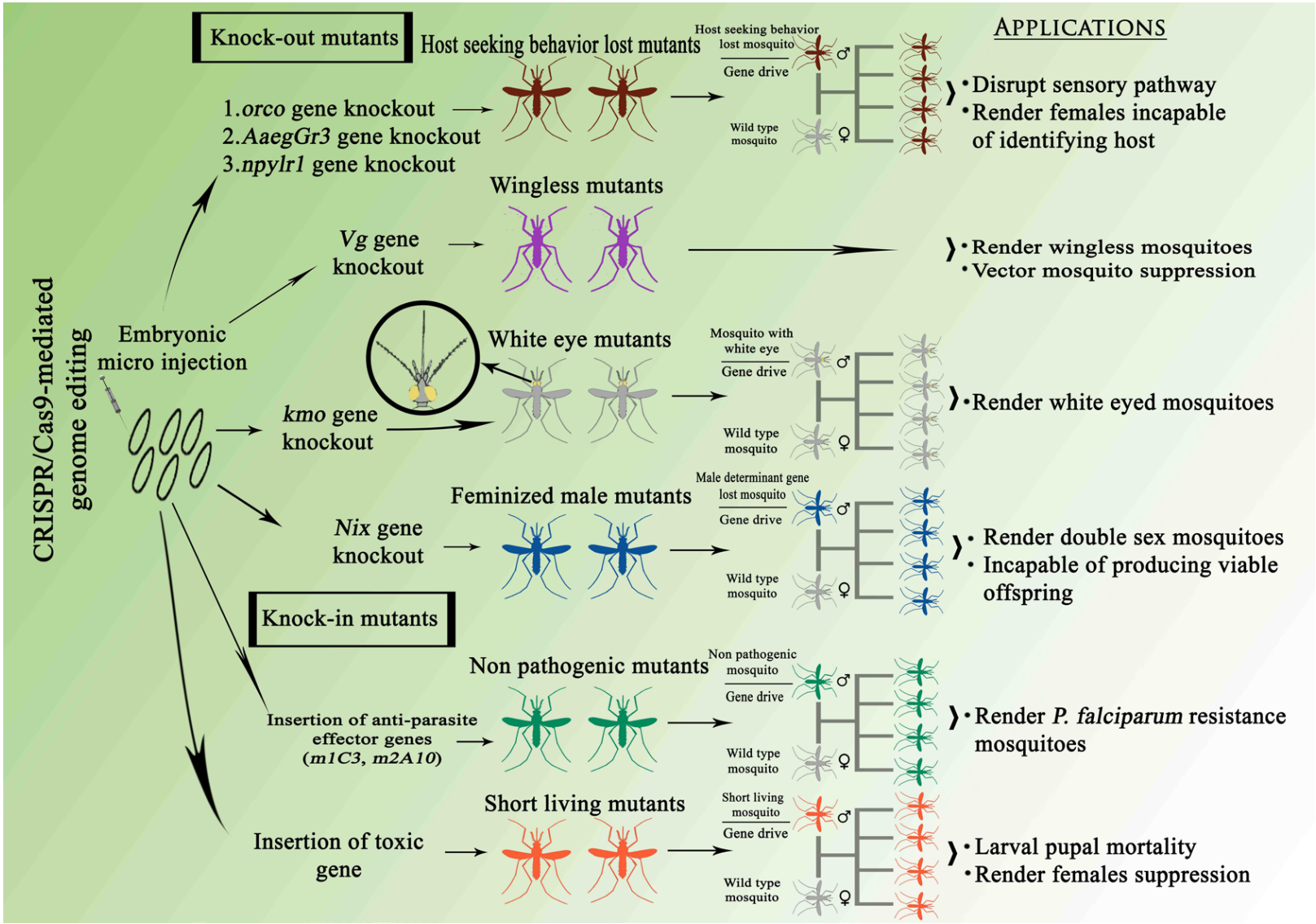
GENE DRIVE

CRISPR gene editing can be used to propagate a genetic modification rapidly through generations. It might be used to eradicate a population of disease-carrying mosquitoes.



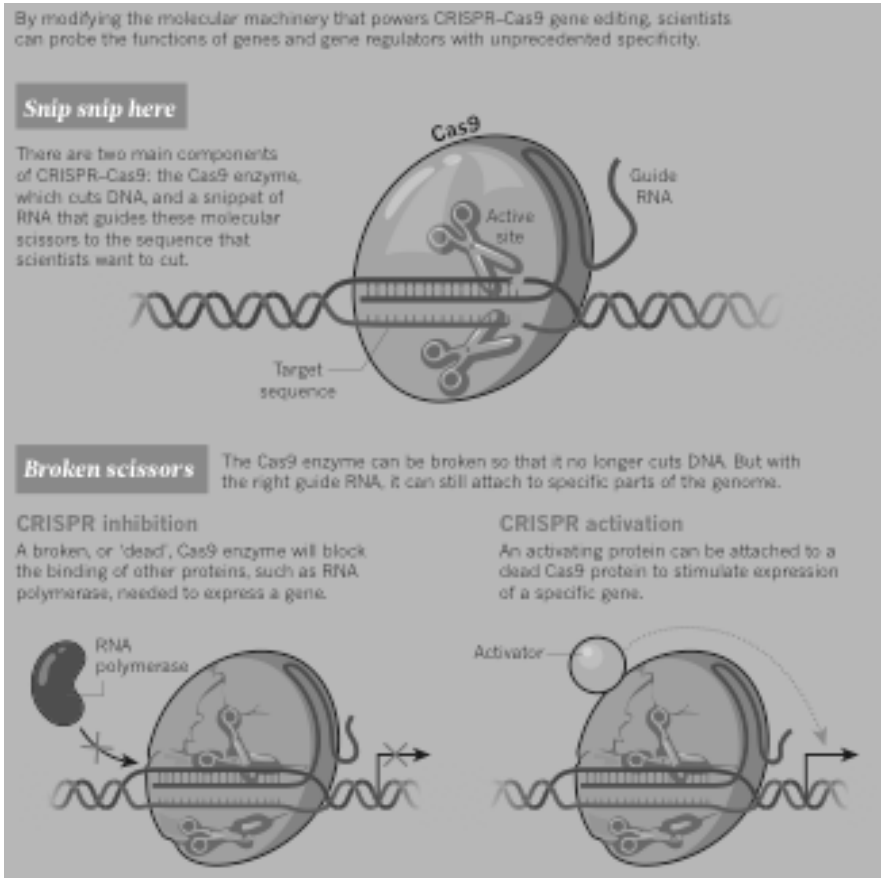


Using CRISPRcas9/Gene Drive to wipe out malaria



BioScience Trends. 2016; 10(6):424-432.

New modifications of CRISPRcas9 broaden its uses in genetic regulation



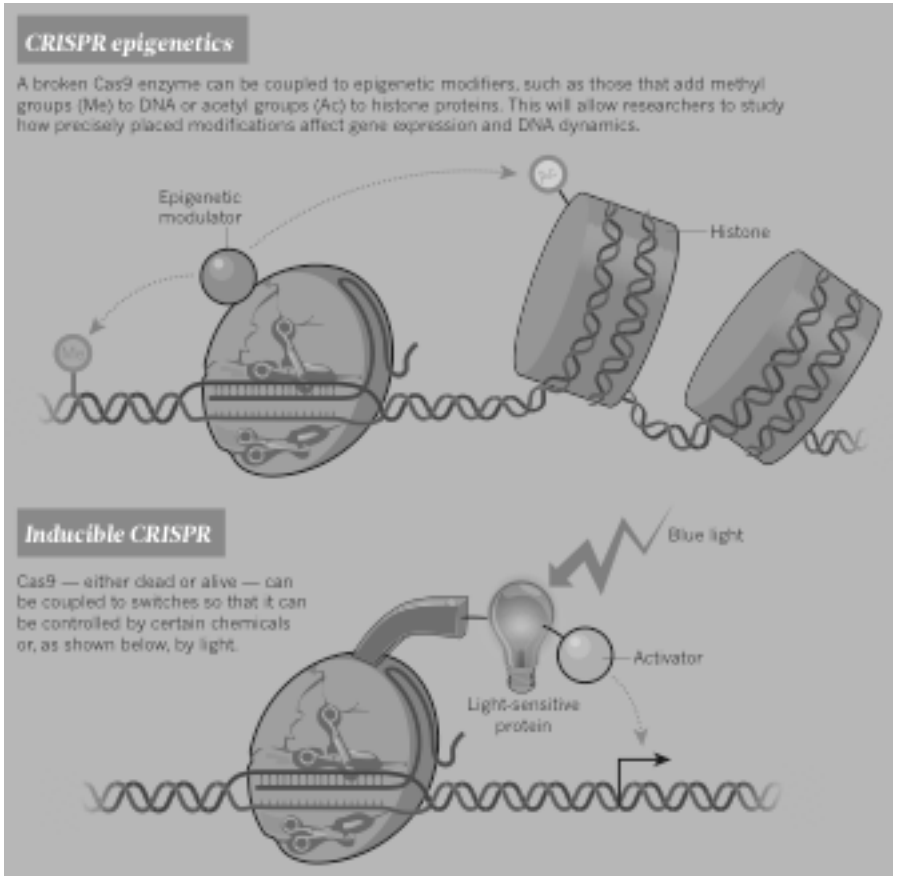


Fig. 1 Timeline of CRISPR-Cas and genome engineering research fields.Key developments in both fields are shown.

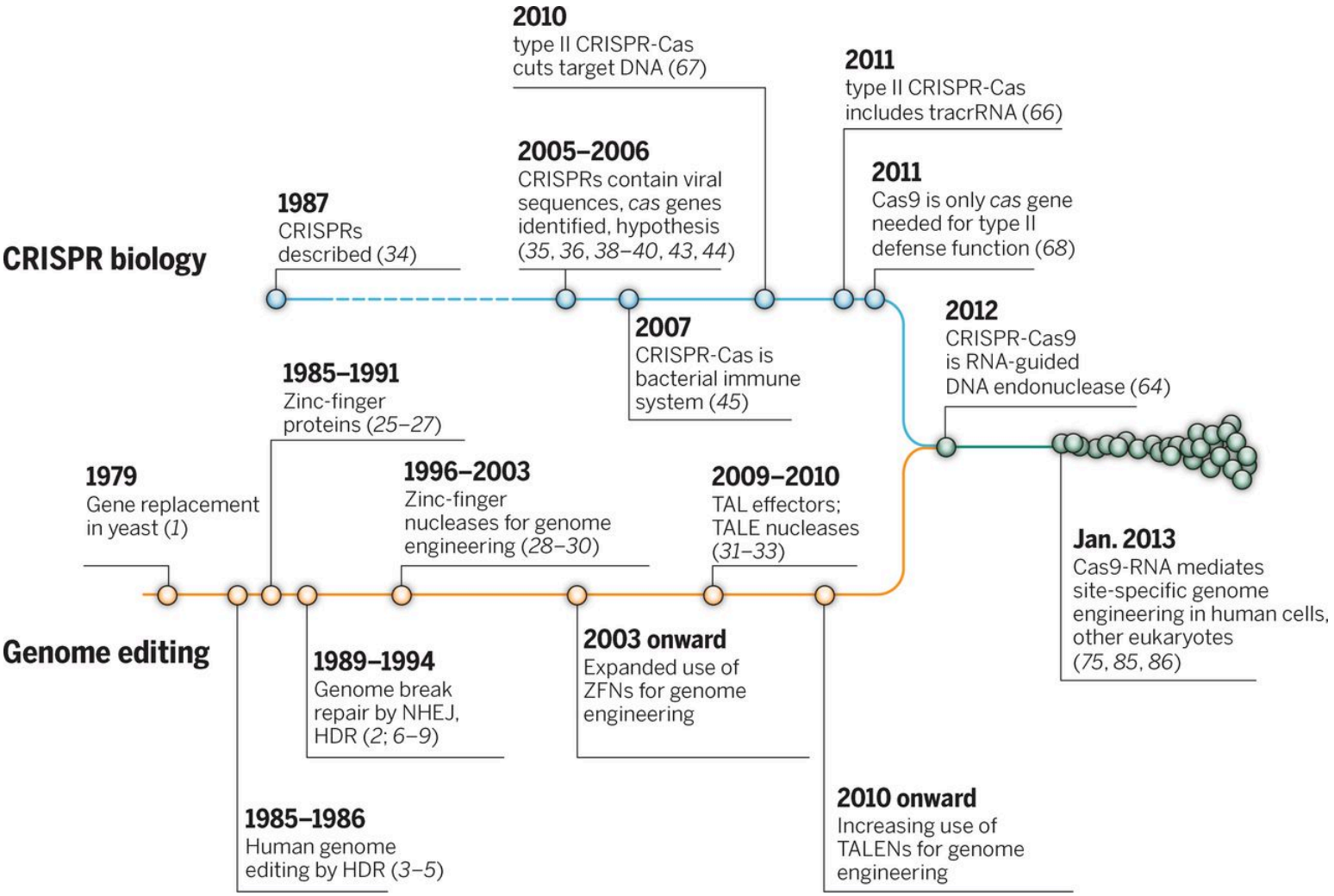


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Fig. 2 Biology of the type II-A CRISPR-Cas system.The type II-A system from S. pyogenes is shown as an example.

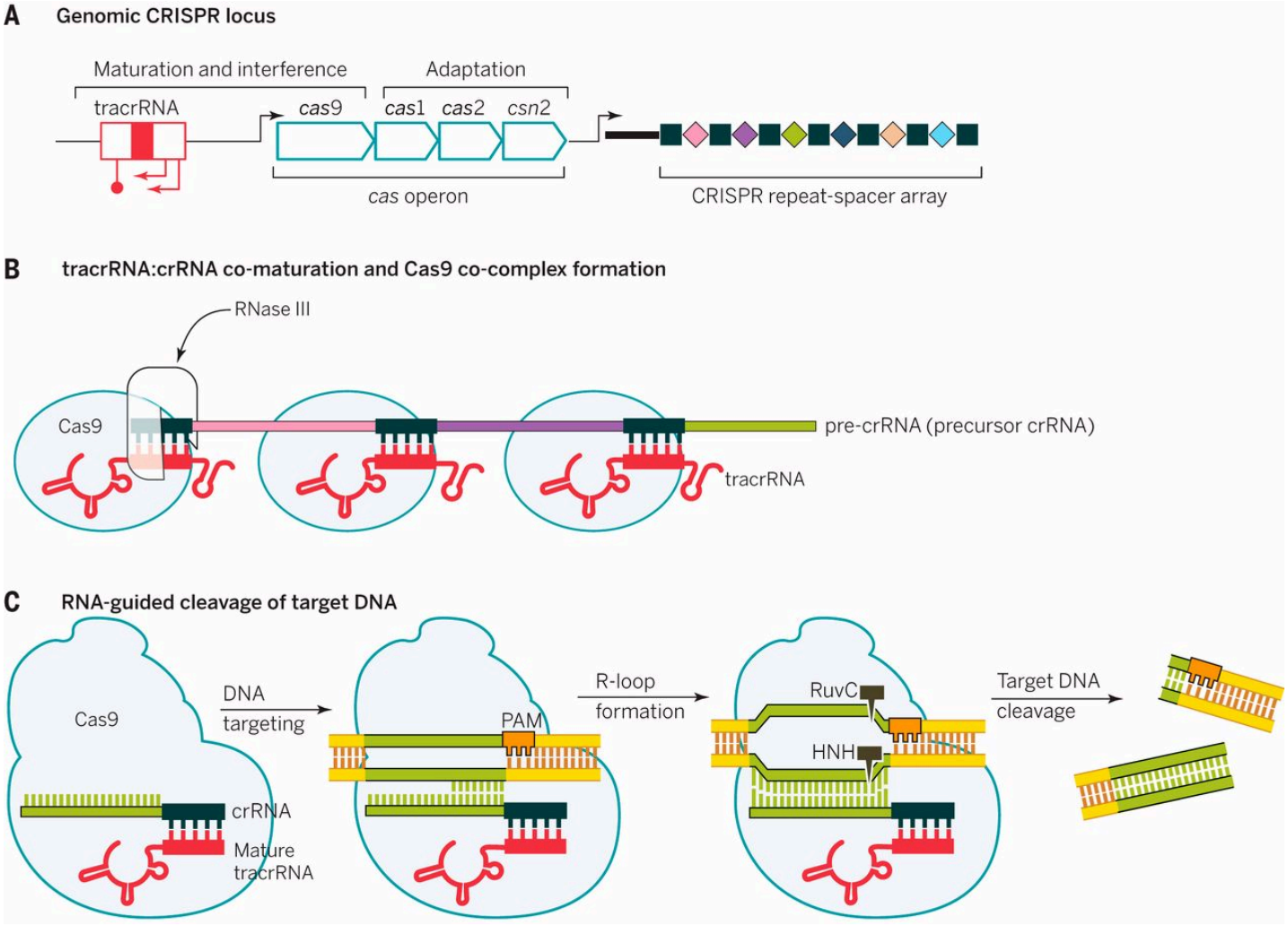

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Fig. 3 Evolution and structure of Cas9.The structure of S. pyogenes Cas9 in the unliganded and RNA-DNA–bound forms [from (77, 81)].

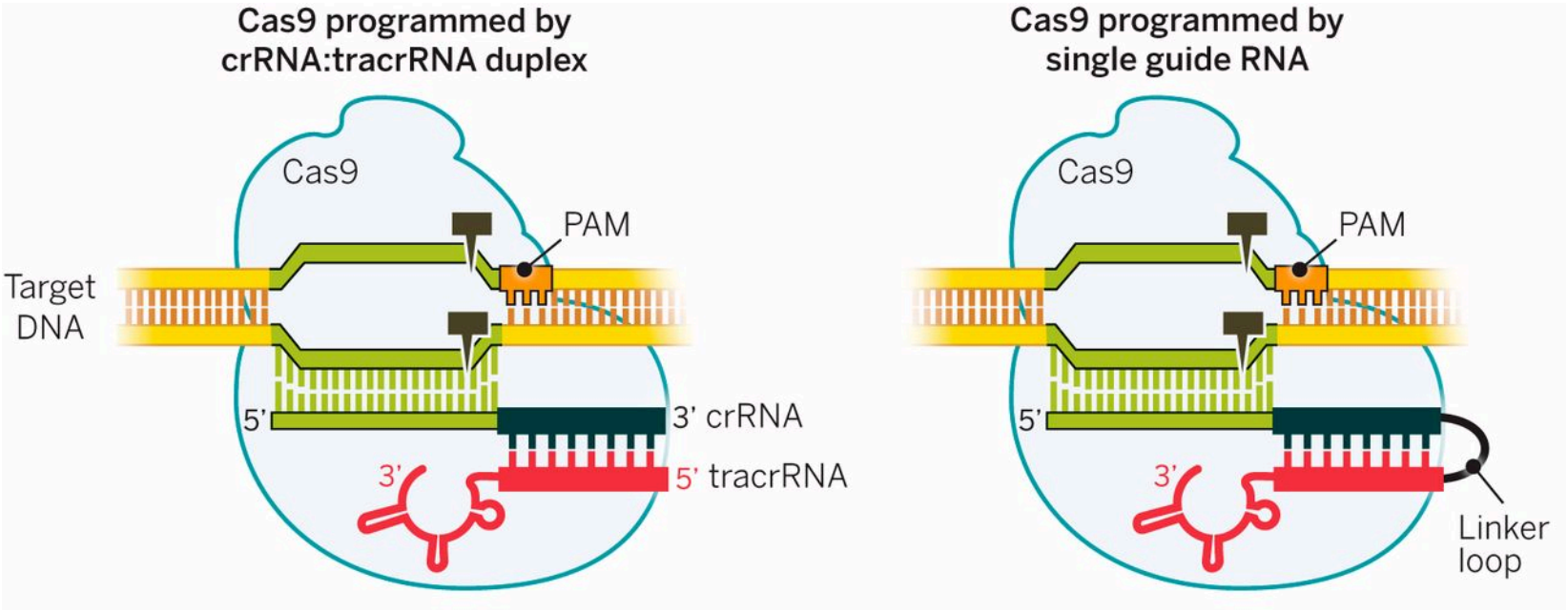

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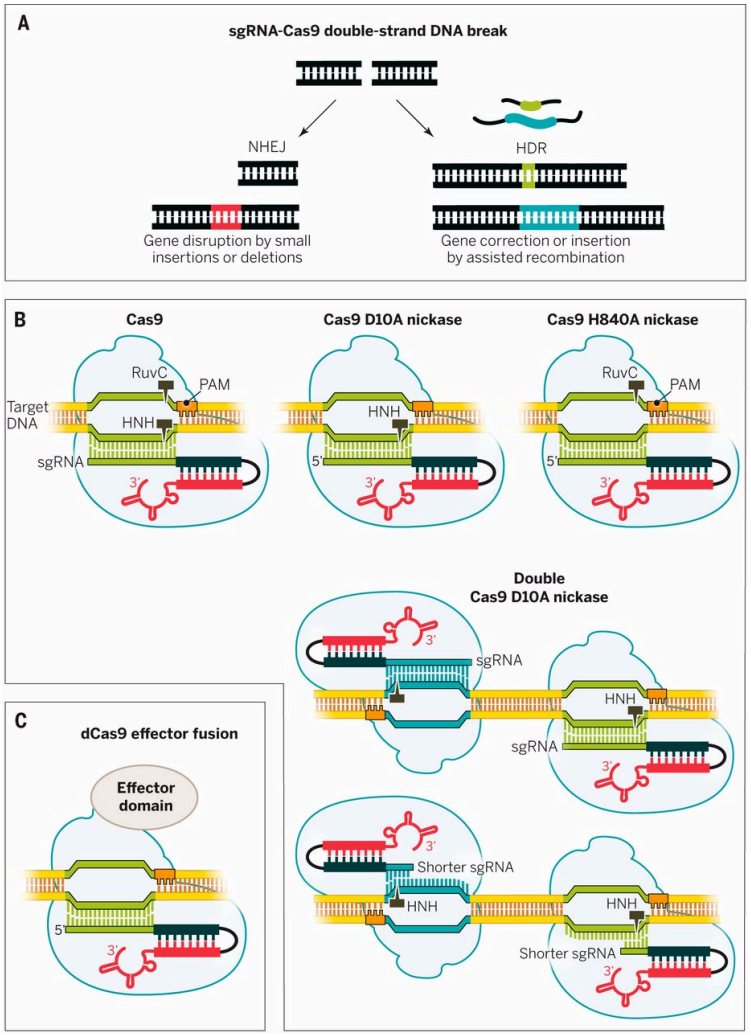
Fig. 4 CRISPR-Cas9 as a genome engineering tool.(A) Different strategies for introducing blunt double-stranded DNA breaks into genomic loci, which become substrates for endogenous cellular DNA repair machinery that catalyze nonhomologous end joining (NHEJ) or homology-directed repair (HDR).



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