Figure 9.14: Gram $\oplus$ can detect density of surroundings: sense other bacteria $\rightarrow$ send out/catch DNA via transformation
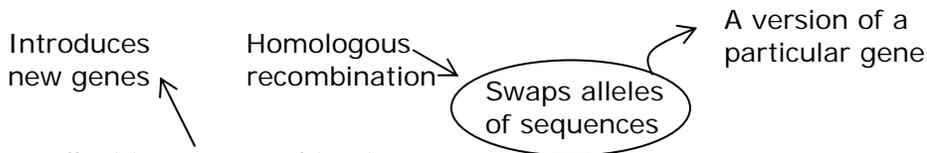
- Transformation (cont.)
    - G$\ominus$: either always competent or can be induced by physiological state or environmental conditions.

- Transduction
    - Consequence of errors in development of phages
    - Generalized transduction
    - Specialized transduction (lysogenic/temperate phage)

- Conjugation
    - Transfer of plasmids
    - <u>F plasmids</u> (fertility)

        $\hookrightarrow$ <u>tra</u> genes $\rightarrow$ transfer: sex pilus

    - <u>Hfr</u> (High Frequency of Recombination) plasmids
    - Plasmids can insert into chromosome $\rightarrow$ can transfer large pieces of host chromosome between cells while being transferred itself.

Fate of Transferred DNA

- Degradation by nucleases (example: restriction nucleases)
- Stabilization by circularization
- Homologous recombination (into chromosome)
    - Rec A (homologous recombination)

        $\hookrightarrow$ Results in patched or spliced DNA

Ensures that things you (DNA) take up are not too dissimilar from what you (DNA) have.

Recombination frequency

Sequence differences

Introduces new genes — Homologous recombination → Swaps alleles of sequences → A version of a particular gene
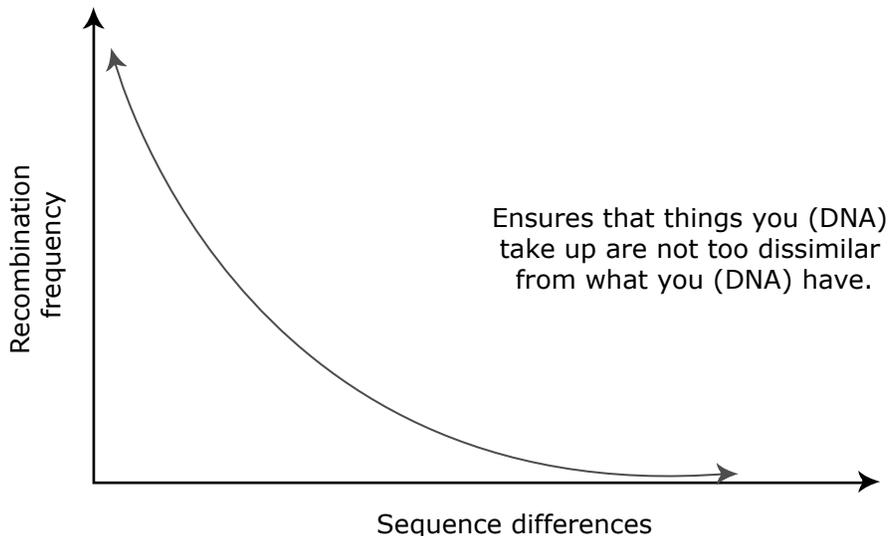
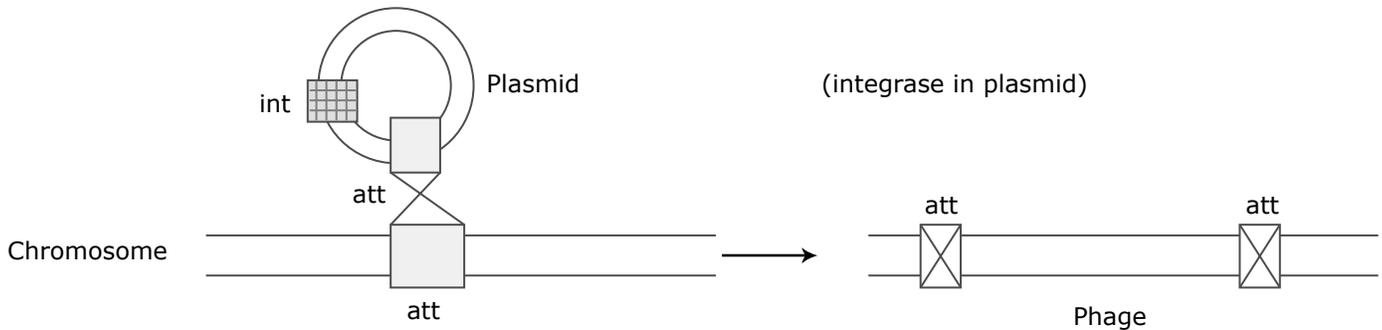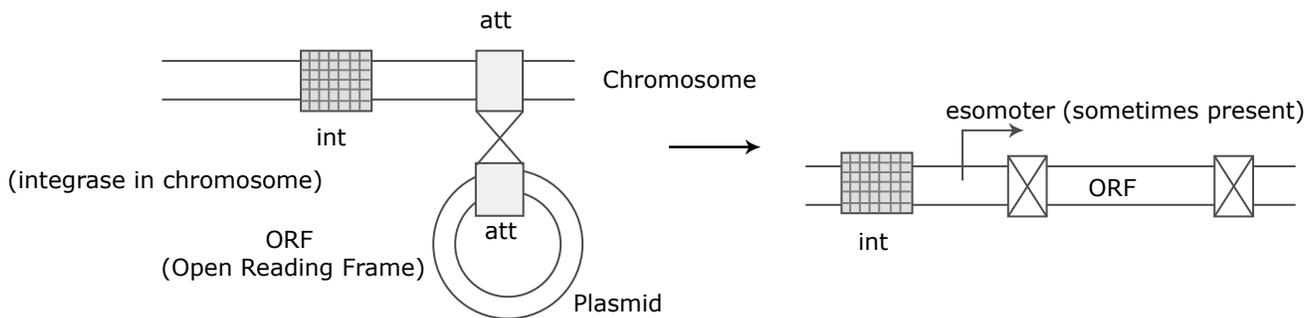- Illegitimate recombination
  ↳ mediated by integrases. Important because can be expressed is promoter available.

a) Phage:

int   Plasmid   (integrase in plasmid)

att

Chromosome

att   att   att

                                 Phage

b) Integrons:

att

int   Chromosome

(integrase in chromosome)   esomoter (sometimes present)

ORF   ORF
(Open Reading Frame)   att   int

Plasmid

- <u>Point Mutation</u> Rate: 1.5×10^{-10} mistakes/bp/generation (mistakes that escape repair mechanism)

- Gene transfer between phages: 1 in 10^8 infections will lead to gene transfer
  Note: there are 20 million billion gene transfers per second in the ocean
  10^6 cells/mL sea water

Taxonomy: reliable classification with the goal of identification.

Phylogeny: uses evolutionary relationships to classify.
  ↓
DNA sequences serve as evolutionary chronometers: can show relationship

- Genes: must be universally distributed, functionally conserved.

To be used as phylogenetic classifiers,
genes must fit these conditions

Phylogeny: genes must be universally distributed functionally conserved, & have an appropriate rate of change (point mutations)

Example: universal genes:
- o 16 S rRNA genes
- o RNA polymerases
- o RecA
- o ATPases

Traced back to one ancestor
Can't have length variation

- 16 S rRNA – prominent role in phylogeny

Genes have three regions:
  a) universally conserved
  b) length is conserved
  c) neither length nor sequence are conserved

Alignment: Regions number 1 & 2

Evolutionary distance = % difference nucleotides

Example:

0.31

0.23   A

0.085

0.08

B

0.15

C

0.29

D