Figure 9.14: Gram ⊗ can detect density of surroundings: sense other bacteria → send out/catch DNA via transformation

- Transformation (cont.)
  - G◯: 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
  - F plasmids (fertility)
    - tra genes → transfer: sex pilus
  - Hfr (High Frequency of Recombination) plasmids
    - Plasmids can insert into chromosome → can transfer large pieces of host chromosome between cells while being transferred itself.

Fate of Transferred DNA

- Degradation by nuclease (example: restriction nuclease)
- Stabilization by circularization
- Homologous recombination (into chromosome)
  - Rec A (homologous recombination)
    - Results in patched or spliced DNA

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

b) Integrons:

- **Point Mutation Rate**: $1.5 \times 10^{-10}$ 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:
  - 16 S rRNA genes
  - RNA polymerases
  - RecA
  - ATPases

• 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: