

Lysogeny

Stable relationship between the phage and the host

- **Temperate phage:**
- **Lysogen: bacterium harboring a prophage in its genome**
- **Prophage:**
 - **Prophage are not taxing to the host cell since only a few proteins are necessary to maintain lysogeny**
- **If host cell suffers lethal damage, induction into the lytic cycle occurs**

Stages of lysogeny:

Lambda Lysogenic Cycle

1)

2) Synthesis of early mRNA and protein by host

3)

4) Synthesis of late mRNA

5) Activation of P_{RE} , P_I , P_{anti-Q}

↳ P_{RE} (repressor establishment):

P_I :

P_{anti-Q} : yields antisense RNA to Q mRNA

6)

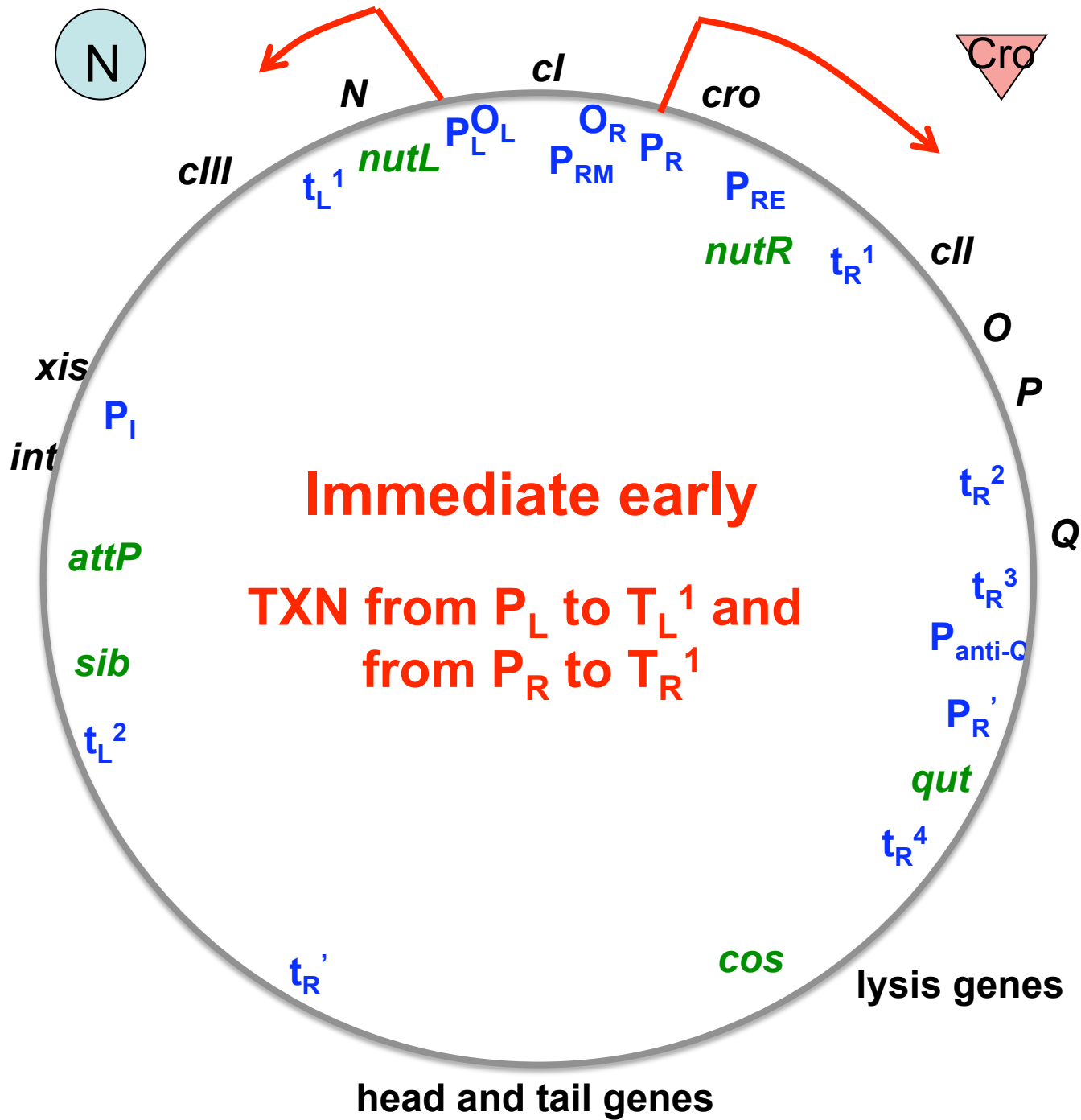
3 Phases of the Lysogenic Cycle

1) Immediate early

- Host RNAP transcribes from P_R to t_R^1 and P_L to t_L^1

2) Delayed early

- P_L to t_L^2 : mRNA for production of N, CIII, Xis, Int, *sib*
- P_R to t_R^3 : mRNA for production of: Cro, CII, O, P, Q



3) Late Lysogenic:

A. Host proteases HflA/HflB are not produced in an unhealthy cell



B. Transcript from P_i contains only the *int* ORF for increased production of integrase for lambda genome integration into the *E. coli* chromosome

C. Txn from $P_{\text{anti-Q}}$ produces Q antisense RNA which binds to the Q mRNA preventing translation

➤ **Without Q protein, txn from P_R terminates at t_R4 preventing expression of the late genes needed for lysis**

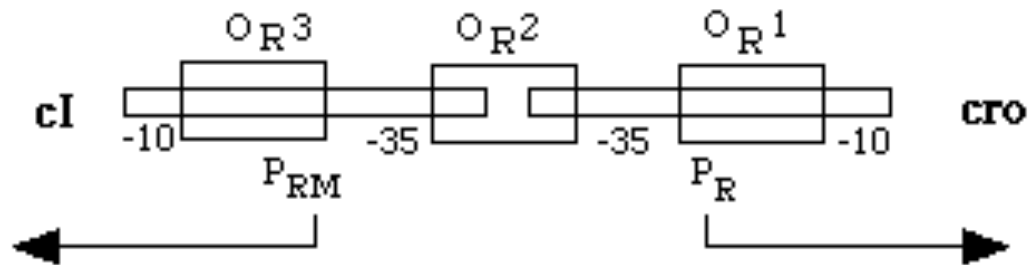
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➤ *cro* antisense prevents tln of *cro* mRNA which ultimately decreases the amount of the Cro repressor

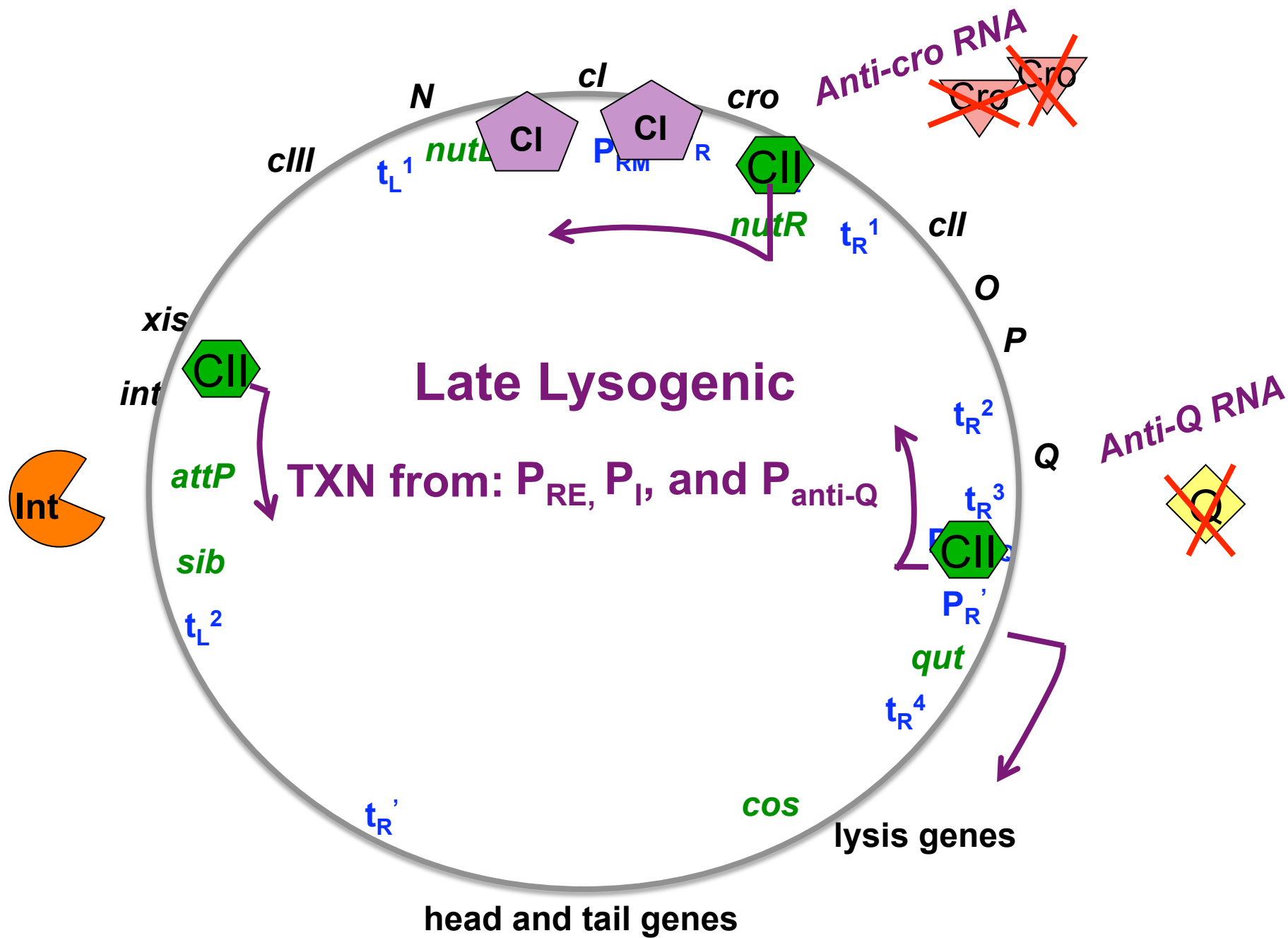
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➤ CI is considered the lambda repressor, which competes with Cro for operator sites

↳ CI affinity:

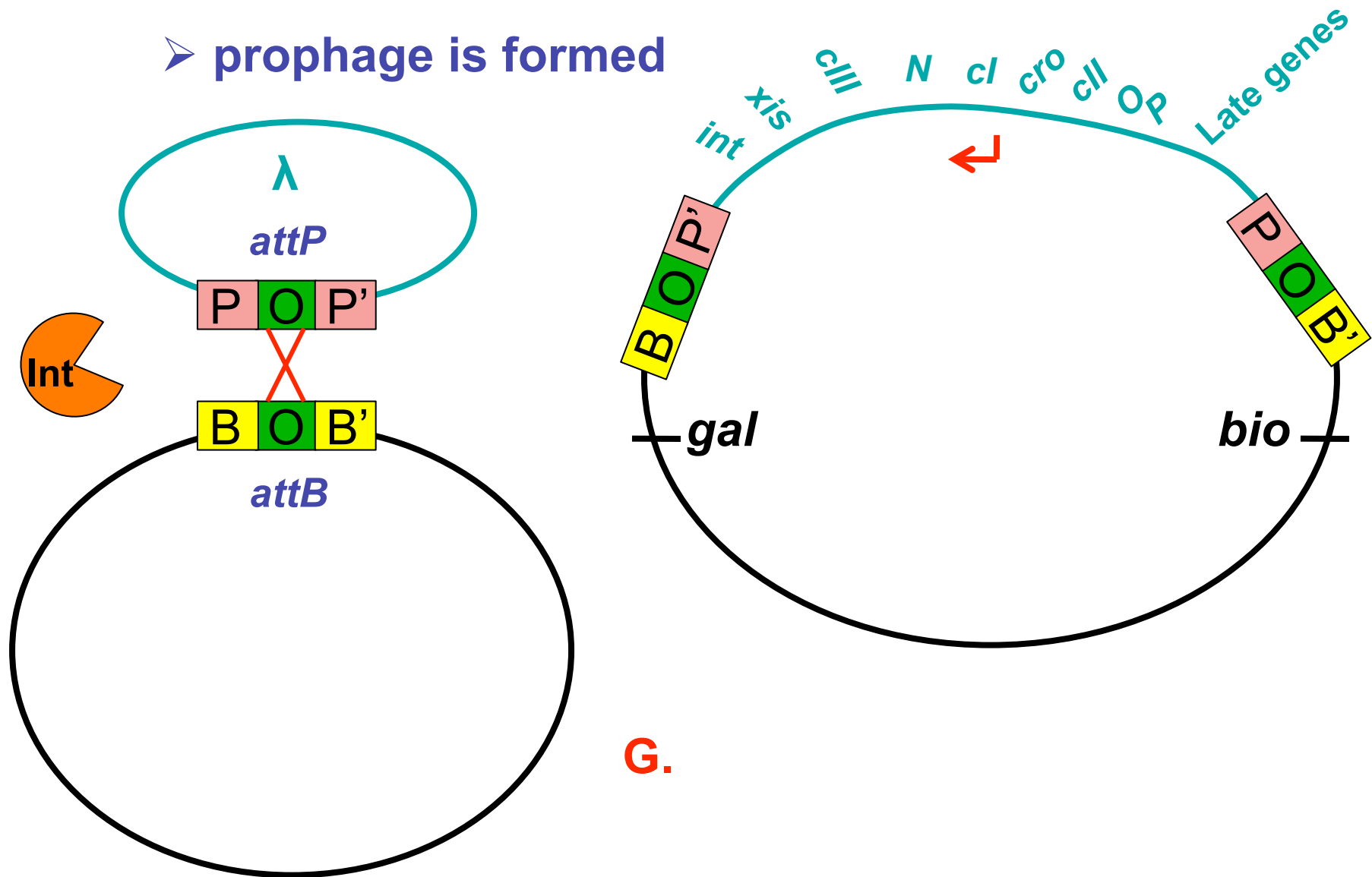


- ✧ txn from P_R repressed by O_{R1} and O_{R2} binding
- ✧ txn from P_L repressed by O_L binding
- ✧ txn from P_{RM} **activated** by O_{R2} binding
- ✧ txn from P_{RM} repressed by O_{R3} binding



F. λ DNA integrates into the host chromosome by homologous recombination at the *attP* site of lambda and the *attB* site of *E. coli*

➤ prophage is formed



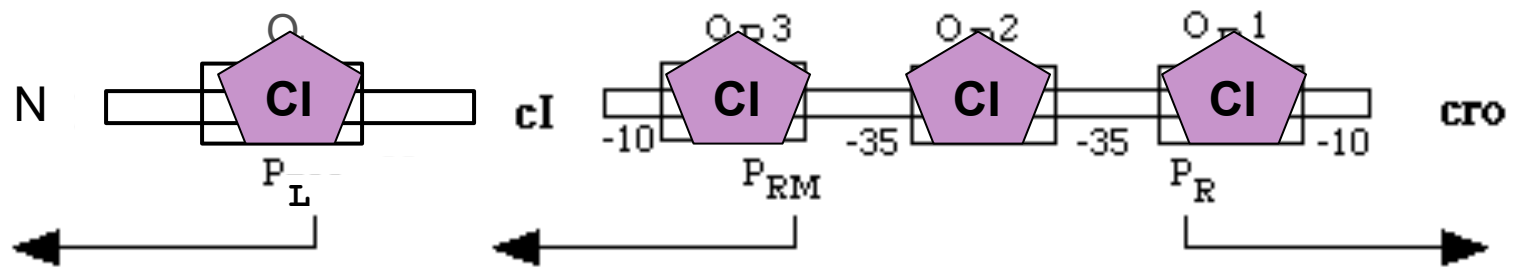
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Maintenance of Lysogeny

Concentration of CI is the controlling element

If the level of the λ repressor gets too high in a lysogen, then the switch to induction could not occur when the host becomes damaged

CI affinity:



No CI
Low [CI]
High [CI]

+	-	+
-	+	-
-	-	-

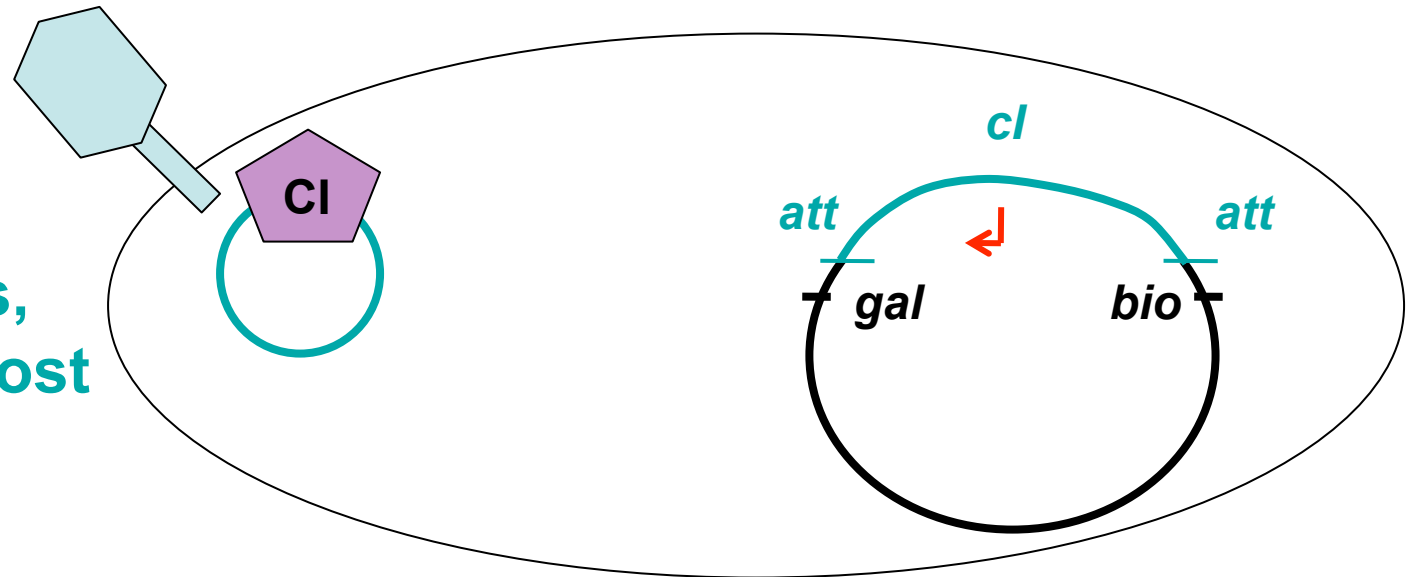
CI and Immunity to Superinfection

What happens if another λ phage tries to infect a λ lysogen?

- The λ lysogen is considered immune because it is expressing CI

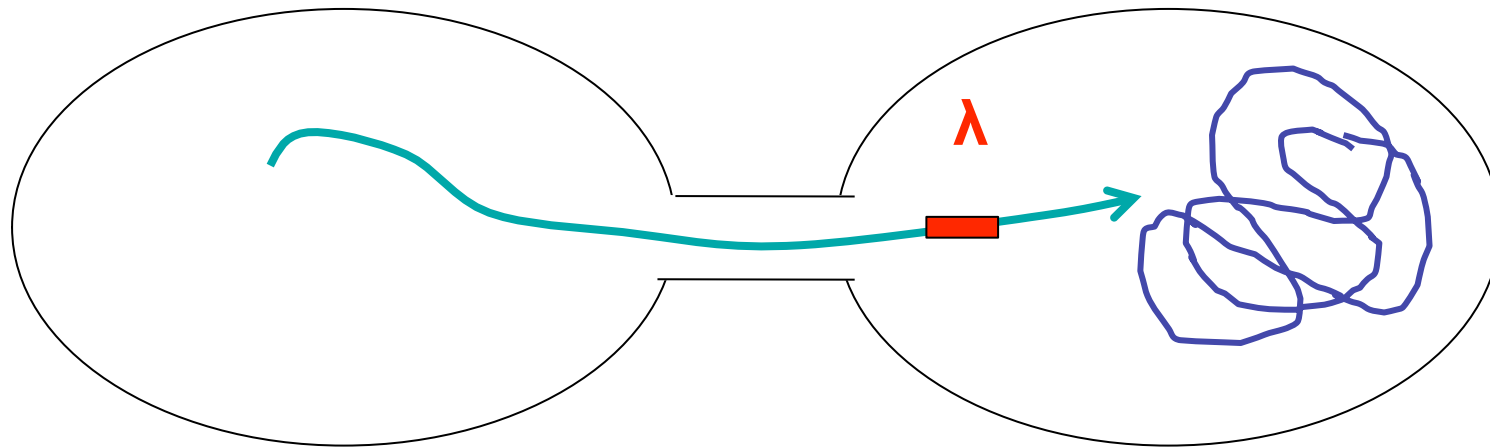


As cell divides,
new λ will be lost



Zygotic Induction

What happens if a lysogen is also a Hfr strain?



**Donor: Hfr and
 λ lysogen**

**Recipient: F⁻ and
NOT a lysogen**

- Immediate early phase begins



Review of Steps Leading to Lysogeny