1. Convincing you to care about CRP-cAMP activation
2. Moving on: λ and friends
3. λ lysis-lysogeny choice
4. P1: another temperate phage

CAP stimulation of initiation

\[ \text{lac: increases RNA pol binding/cc formation} \]

\[ \text{gal: increases open complex formation} \]

Phage infectious cycle

\[ \text{Specific binding of phage to particular cell surface feature (partially defines host range).} \]

\[ \text{Many phage show temporal regulation of gene expression; usually, transcriptional control is key.} \]
Phage λ

48.5 kB linear dsDNA genome
Receptor: LamB porin in OM
Essential genes for lytic replication with single letter names

λ Lytic replication

- Upon entering cell, linear λ DNA circularizes
- Early replication is θ form
- Late replication for production of progeny genomes is rolling circle, producing concatamers
- Sequence-specific cleavage of DNA concatamers at cos prior to packaging in progeny capsids

The temperate phage λ: lysis or lysogeny

λ Lysis-lysogeny up close

- Figure 8.1
- Figure 8.2
- Figure 8.13
N: making it all possible

Figure 8.4

Why call the genes $cI$, $cII$, $cIII$

Table 8.3

<table>
<thead>
<tr>
<th>Steps leading to lytic growth</th>
<th>Steps leading to lysogeny</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Transcription from $\beta_I$ and $\beta_II$</td>
<td>1. Same as for lytic growth</td>
</tr>
<tr>
<td>2. N and Cro are made</td>
<td>2. Same as for lytic growth</td>
</tr>
<tr>
<td>3. N allows CI expression</td>
<td>3. Same as for lytic growth</td>
</tr>
<tr>
<td>4. CI degraded</td>
<td>4. CI stable</td>
</tr>
<tr>
<td>5. Low CI concentration means that little CI is made</td>
<td>5a. High CI concentration activates $\beta_I$ and so Int is made and $\lambda$ DNA integrates</td>
</tr>
<tr>
<td>6. Cro binds at $Q_1^L$ and $Q_2^L$, blocking binding by any low level of CI that is made</td>
<td>6. CI outcompetes Cro, and so CI binding at $q_0$ and $q_1$ both represses $\beta_I$ and $\beta_II$ and positively autoregulates at $\beta_II$, maintaining lysogeny</td>
</tr>
<tr>
<td>Meanwhile, N allows O and P replication gene transcription</td>
<td>7. High CI concentration activates $\beta_{II}$ and so CI is made</td>
</tr>
<tr>
<td>8. A second anti-terminator, $Q_2$, allows late gene transcription, and so $\lambda$ phage particles are made</td>
<td></td>
</tr>
</tbody>
</table>

Figure 8.7
Inducing lysogens

- The regulatory circuit is relatively simple: cl repressor only needs to bind to two operator regions to shut down lytic gene expression.
- cl activates its own transcription (from promoter near $o_{R2}$; Fig 8.10)
- Induction of lysogen (DNA damage/SOS response) leads to cl cleavage and loss of repression.

\[ \begin{align*}
\text{Figure 8.11} & \quad \text{Figure 8.11}
\end{align*} \]

\[ \begin{align*}
\text{Phage P1} & \\
& \quad \text{λ lysogens}
\end{align*} \]

\[ \begin{align*}
\text{λ: resistance vs immunity} & \\
& \quad \text{Resistance to phage: the phage cannot infect.}
\end{align*} \]

- Immunity is the resistance of a lysogen to re-infection (super-infection) by a similar phage.

  This can be observed: ability of lysogens to grown in a plaque of phage (turbid plaques). λ lysogens contain about 100 copies cl repressor/cell.

\[ \begin{align*}
\text{Phage P1} & \\
& \quad \text{infects broad range of bacteria (using LPS core in OM of Gram neg. bacteria), but only replicates efficiently in } E. \text{ coli (and close cousins)}
\end{align*} \]

- Linear 92.6 kb dsDNA genome: like many large phages, several accessory genes (e.g., tRNA genes).
- DNA circularizes upon entry to cell.
- Temperate phage
- Approximately 120 genes, organized into 45 operons; only 4 operons involved in lysis-lysogeny choice.
- Lysogeny by P1 depends on its specific repressor protein, C1.
P1: genome & repressor C1

- 17 operons controlled by C1 repressor and transcribed by σ70 holoenzyme.
- c1 gene located in one of the immunity regions of phage genome.
- Site-specific recombination system of cre-lox, which we’ll talk about later in quarter.

P1 lysogens

- Different from λ in that P1 prophage replicates separately from bacterial chromosome as a plasmid.
- P1 lysogens are stable (loss = 10⁻⁵)
- As the P1 genome is separate from the host cell chromosome, the P1 prophage must express additional functions than λ for maintenance of lysogeny. these include?

P1 and molecular genetics

Ability of P1 to move bacterial DNA around as “generalized transducing phage” has been important for molecular genetics.

This property of P1 due to the mechanism of preparing dsDNA for packaging into capsids.

Lytic growth of P1 produces majority of normal phage…