Lysogenic Consequences

1. Lysogenic cells cannot be reinfected by the same prophage (other phages however can still cause infection).

2. Host cells may undergo lysogenic conversion where they now show new properties. For example, the prophage may carry a gene coding for a toxin. As a result of this conversion, the bacterial cell may now produce a dangerous protein toxin which is encoded by the viral genes. The following bacterial organisms are believed to have gained their toxin producing capabilities as a result of lysogenic conversion:
   a. Corynebacterium diphtheriae
   b. Streptococcus pyogenes
   c. Clostridium botulinum
   d. Bacillus anthracis
   e. Yersinia pestis

3. Prophages in lysogenic cells can facilitate specialized (restricted) transduction. The prophage can only attach in specific areas upon the host chromosome. When the prophage pulls away it can bring along the adjacent genes from the host cell. This feature has been used advantageously by scientists to move about specific genes. (See figure in Ch. 13 on movement of gal gene).

Replicative Cycle of Bacteriophage

1. Adsorption (attachment)- adsorption is the attachment to solid surface. Through chance collisions the appropriate phage bumps into the correct host bacterial cell. Specific receptors on the tail fibers will match up with receptor sites located on the cell wall, fimbriae, flagella or other external areas of the bacterial host cell. Viral adsorption involves steric complementarity of the virus and the host receptor sites. Weak electrostatic bonds are formed from chemical interactions.

2. Penetration- after attachment, the T-even phage injects its DNA (viral genome) into the bacterial host cell. The remainder of this complex virus stays outside. The tail and associated enzymes of the T-even phage function in facilitating this penetration process. Phage lysozyme will help break down the bacterial cell wall.

3. Biosynthesis
   a. Host DNA is degraded and host protein synthesis is stopped. Viral proteins interfere with host cell transcription and translation.
   b. Host cell ribosomes, enzymes and amino acids are used for translation of viral proteins.
   c. Phage nucleic acid, capsid proteins and phage enzymes are synthesized.

The eclipse period is time in which complete infective virions are not present. It starts when the phage nucleic acid is injected into the host cell and ends after late maturation.
Polyribosomes may be observed in cells where viral particles are replicating. Normally there is only 1 ribosome on mRNA at a time. Viruses however, need to act quickly and efficiently and in infected cells many ribosomes may use the same mRNA at one time.

4. Maturation and assembly-bacteriophage DNA (nucleic acid) and capsids are made separately and then assembled (copolymerized) in this phase. Tail fibers, the contractile sheath and the base plate are also made separately and then assembled. All of the viral components assemble spontaneously minimizing the number of viral genes assigned to this process.

5. Release-viral genes encode for the enzyme lysozyme. This enzyme causes the bacterial cell wall to break down resulting in lysis of the host cell. Viral particles are now released.

Burst time is the total time from adsorption to release. This takes approximately 20 to 40 minutes.

Burst size refers to the total number of viral particles that are formed in one host cell during the replicative cycle. Numbers vary from 100 to 1000 particles.

Reproductive Cycle of an Animal Virus

1. Adsorption (Attachment)-viral particle receptors target specific receptors upon host cells. The match is highly specific and like the phage model we see steric complementarity. With icosahedral viruses the viral receptor sites are located on the corners of the icosahedrons. Viral receptor sites can also be located upon spikes when these structures are present. Proteins and glycoproteins upon the host cell plasma membranes serve as the receptor sites on the host cells. Host cell plasma membranes can vary from one individual to another. This may explain why one person is susceptible to virus while another is not.

2. Entry-the entire viral particle may enter by pinocytosis. The viral particle is surrounded by host cell plasma membrane and brought into the cell as the plasma membrane folds inward. Once inside the cell the virus in now in a vesicle. Enveloped viruses can be brought into the cell by a process known as fusion.

3. Uncoating-unlike the phage model, the capsid along with the viral nucleic acid is brought inside the host cell and therefore must be removed in the uncoating process prior to biosynthesis. The eclipse phase does not start until after uncoating. Enzymes that remove the capsid are typically made from host cell enzymes. An exception to this rule occurs during the uncoating of the pox viruses. Pox viruses are large and they use their own genes to make enzymes for uncoating.

4. Biosynthesis

   a. DNA viruses—generally viral nucleic acid is replicated in the host cell nucleus using viral enzymes. The capsid and other proteins are made in the cytoplasm using host cell enzymes. Virions are assembled in the nucleus of the host cell. Pox viruses are the exception as they are DNA viruses that are completely synthesized in the cytoplasm.

   b. RNA viruses—viral RNA (genes) is synthesized in the host cell cytoplasm. The capsid and other proteins are also made in the cytoplasm. Virions are assembled in the cytoplasm.