Cytopathic effect (CPE) is noticed as the monolayer cells deteriorate as a result of the viral infection. This destruction of the tissue cells in monolayer allows for easy monitoring and assessment of viral growth. This visualization is not apparent when cells are in suspension. Primary cell lines will divide and reproduce for a few generations and then will die. The viral culture will disappear along with these host cells at the time of death. This may be a problem for the researchers. Diploid cell lines make use of embryonic tissues for the culturing of viruses. These cell lines can be maintained for approximately 100 generations. The rabies virus that is used for rabies vaccine is grown in diploid cell lines and is sometimes referred to as diploid culture vaccine. Continuous cell lines use cancer cells for culturing viruses. These cell lines can go through an infinite number of generations and are sometimes referred to as immortal. This is ideal for maintaining a viral culture for purposes of research and study. A famous continuous cell line is called the HeLa cell line after Henrietta Lacks who provided these cancerous cells. She died in 1951.

4. Use bacterial host cells for culturing bacteriophages.

Quantification of viral populations

1. Using electron microscopy, one can count the particles in a viral preparation. This is time consuming, costly and laborious. Furthermore, one cannot differentiate between those particles which are infectious (virion) vs. noninfectious by just looking at them. However, it does provide an absolute count.

2. LD (Lethal Dose) 50 or ID (Infectious Dose) 50 methods—scientists get a relative idea of the potency of a viral preparation. The LD 50 method finds the concentration of a viral preparation at which 50% of the test animals will die. The ID 50 method finds the concentration of a viral preparation at which 50% of the test animals are infected. In comparing two viral preparations, create a series of dilutions of both preparations and inject these into the test animals. At which dilution will 50% of the test animals die (LD 50). One can assess the viral concentrations of the two preparations relative to each other based upon which dilution from the two preparations was the LD 50 dilution. If one preparation required more diluting to observe the LD 50 effect, than this was the preparation with more viral quantity.

3. Pock method—pocks are observed as areas of increased growth due to viral replication on embryonic chicken membranes. The chorioallantoic membrane is commonly used. The pocks are observed as “pits” or “bumps” upon the membrane. Counting the number of pocks on two separate chorioallantoic membranes following the inoculation of two viral preparations, allows for the assessment of these viral concentrations. This quantification is relative and only virions provide results.

4. Plaque method—pour plates are created from agar that is mixed with bacteriophage and host bacteria. The host bacterial cells involved with viral replication are destroyed to reveal areas of
clearing in the plates. These clearings are called plaques. Two separate viral preparations are used to create two separate pour plates. Upon examination of the two plates, one can count the number of plaques (clearings) following bacterial host cell growth and viral replication. The plate with more plaques is the plate with more viral particles in the original suspension. This quantification method is relative and only virions produce results.

5. Tissue culture method-tissue cells are grown in monolayer. Viral particles are introduced. Foci of infection can be observed where the tissue cells are damaged or destroyed by the viruses. This pattern of cell destruction is referred to as the cytopathic effect (CPE). Two separate viral preparations can replicate in separate monolayer tissue cultures. The more CPE's in a culture, the greater the viral concentration. This quantification method is relative and only virions produce results.

6. HA titer (hemagglutination end point or titer assays)-some viruses can attach to erythrocytes and form bridges between them. This causes clumping or agglutination of the RBC’s. The influenza virus has this capability. One can check the viral concentration of two separate preparations by creating a series of dilutions of the two preparations and then inoculating these dilutions into RBC’s. The highest dilution the shows agglutination is referred to as the end point. Examine the end points from the two series of inoculations. If the end point established from one of the preparations required an additional dilution, then that preparation is more concentrated. This quantification method provides relative values.

Virus-host relationships

1. Lytic state-virus kills and lyses host cell.
2. Lysogenic state-viral infection without host cell lysis. In this situation, there is no release of viral particles. Virus is in a quiet or in a latent state within the host cell.
3. Viral release without lysis-viral particles are extruded out of the cell without lysis. The host cell is therefore not lysed and killed. This provides the virus with a method for obtaining an envelope.

In some cases, viruses can go from a lytic cycle to a lysogenic cycle or from a lysogenic cycle to a lytic cycle. When one is showing the classical lesions from a Herpes simplex 1 infection (cold sores or fever blisters), the virus is in a lytic cycle and the host cells are being lysed. The virus can then retreat into a lysogenic cycle or phase and remains dormant or latent. UV light, stress or temperature variations can activate the virus into its lytic phase.

The viral DNA from a bacteriophage can integrate into the bacterial host cells chromosome and replicate with the host cell DNA during transverse binary fission without active infection. This inserted phage DNA is known as the prophage or temperate phage or lysogenic phage. The phage remains latent in a state of lysogeny. The host bacterial cell is known as a lysogenic cell. UV light or chemicals or some other spontaneous event can cause the prophage to pop out of the host chromosome and start the lytic cycle. A temperate (lysogenic) phage is therefore capable of both a lysogenic cycle and a lytic cycle within its bacterial host.