Diauxic Growth

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Diauxic growth

- Diauxic growth is the phenomenon whereby a population of microbes, when presented with two carbon sources, exhibits bi-phasic exponential growth intermitted by a lag-phase of minimal growth.
- Originally, the phenomenon was described by Monod demonstrating diauxie with glucose and lactose in *E. coli*.
- In his experiments Monod showed that the population first grows exponentially on glucose until all glucose is exhausted, then stops growing for a considerable amount of time and subsequently resumes exponential growth on lactose.
- The cause of diauxic growth or diauxie is complex and not completely understood, but **catabolite repression or the** glucose effect probably plays a part.

- The enzymes for glucose catabolism are constitutive and unaffected by CAP activity.
- When the bacterium is given glucose, the cAMP level drops, resulting in deactivation of the catabolite activator protein and inhibition of lac operon expression.
- The decrease in cAMP may be due to the effect of the phosphoenolpyruvate:phosphotransferase system (PTS) on the activity of adenyl cyclase, the enzyme that synthesizes cAMP.
- Enzyme III of the PTS donates a phosphate to glucose during its transport; therefore, it enters the cell as glucose 6-phosphate.
- The phosphorylated form of enzyme III also activates adenyl cyclase.
- If glucose is being rapidly transported by PTS, the amount of phosphorylated enzyme III is low and the adenyl cyclase is less active, so the cAMP level drops.
- At least one other mechanism is involved in diauxic growth.
- When the PTS is actively transporting glucose into the cell, nonphosphorylated enzyme III is more prevalent.
- Nonphosphorylated enzyme III binds to the lactose permease and allosterically inhibits it, thus blocking lactose uptake.

- Whatever the precise mechanism, such control is of considerable advantage to the bacterium.
- It will use the most easily catabolized sugar (glucose) first rather than synthesize the enzymes necessary for another carbon and energy source.
- These control mechanisms are present in a variety of bacteria and metabolic pathways.

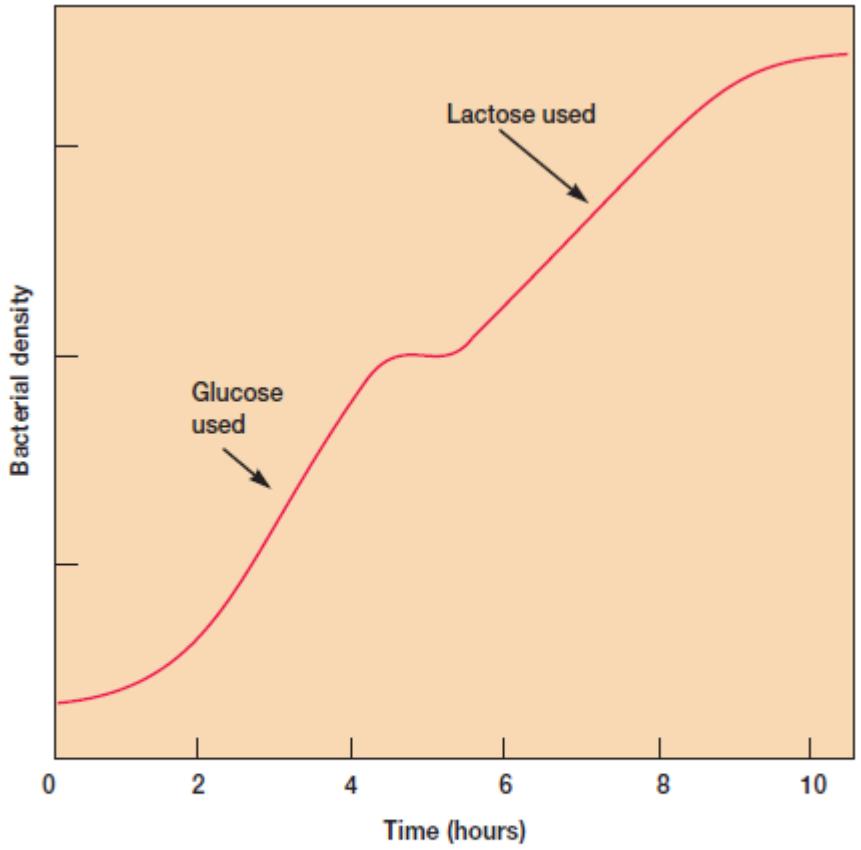

Figure 12.31 Diauxic Growth. The diauxic growth curve of *E. coli* grown with a mixture of glucose and lactose. Glucose is first used, then lactose. A short lag in growth is present while the bacteria synthesize the enzymes needed for lactose use.