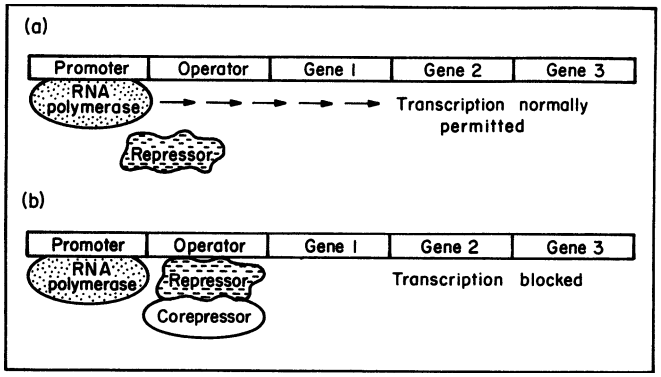

Figure 4.9. Process of enzyme repression. (a) Transcription of the operon occurs because the repressor is unable to bind to the operator. (b) After a corepressor (small molecule) binds to the repressor, the repressor now binds to the operator and blocks transcription. *m*-RNA and the proteins it codes for are not made. (With permission, from T. D. Brock, K. M. Brock, and D. M. Ward, *Basic Microbiology with Applications*, 3d ed., Pearson Education, Upper Saddle River, NJ, 1986, p. 143.)

β-galactosidase (or lactase), which cleaves lactose to glucose and galactose. The lac y protein is a *permease*, which acts to increase the rate of uptake of lactose into the cell. Lactose is modified in the cell to allolactose, which acts as the inducer. The conversion of lactose to allolactose is through a secondary activity of the enzyme β-galactosidase. Repression of transcription in uninduced cells is incomplete, and a low level (*basal level*) of proteins from the operon is made. Allolactose acts as indicated in Fig. 4.10, but induction by allolactose is not both necessary and sufficient for maximum transcription. Further regulation is exerted through *catabolite repression* (also called the *glucose effect*).

When *E. coli* senses the presence of a carbon–energy source preferred to lactose, it will not use the lactose until the preferred substrate (e.g., glucose) is fully consumed. This control mechanism is exercised through a protein called *CAP* (cyclic-AMP-activating protein). Cyclic AMP (cAMP) levels increase as the amount of energy available to the cell decreases. Thus, if glucose or a preferred substrate is depleted, the level of cAMP will increase. Under these conditions, cAMP will readily bind to CAP to form a complex that binds near the lac promoter. This complex greatly enhances RNA polymerase binding to the lac promoter. *Enhancer* regions exist in both procaryotes and eucaryotes.

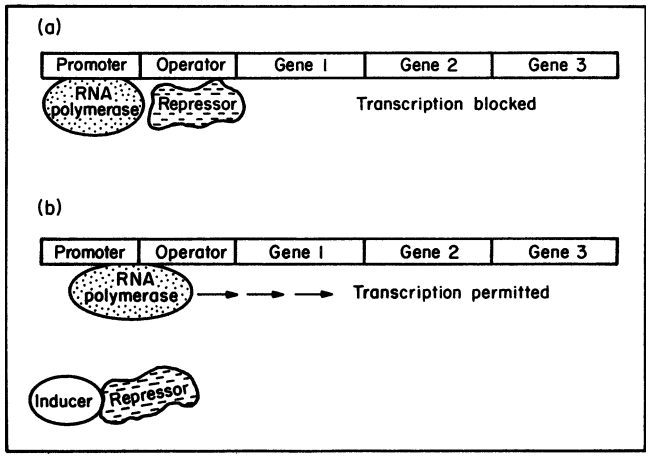

Figure 4.10. Process of enzyme induction. (a) A repressor protein binds to the operator region and blocks the action of RNA polymerase. (b) Inducer molecule binds to the repressor and inactivates it. Transcription by RNA polymerase occurs and an *m*-RNA for that operon is formed. (With permission, from T. D. Brock, K. M. Brock, and D. M. Ward, *Basic Microbiology with Applications*, 3d ed., Pearson Education, Upper Saddle River, NJ, 1986, p. 142.) In the lac operon, gene 1 is lac z, gene 2 is lac y, and gene 3 is lac a. The repressor is made on a separate gene called lac i.