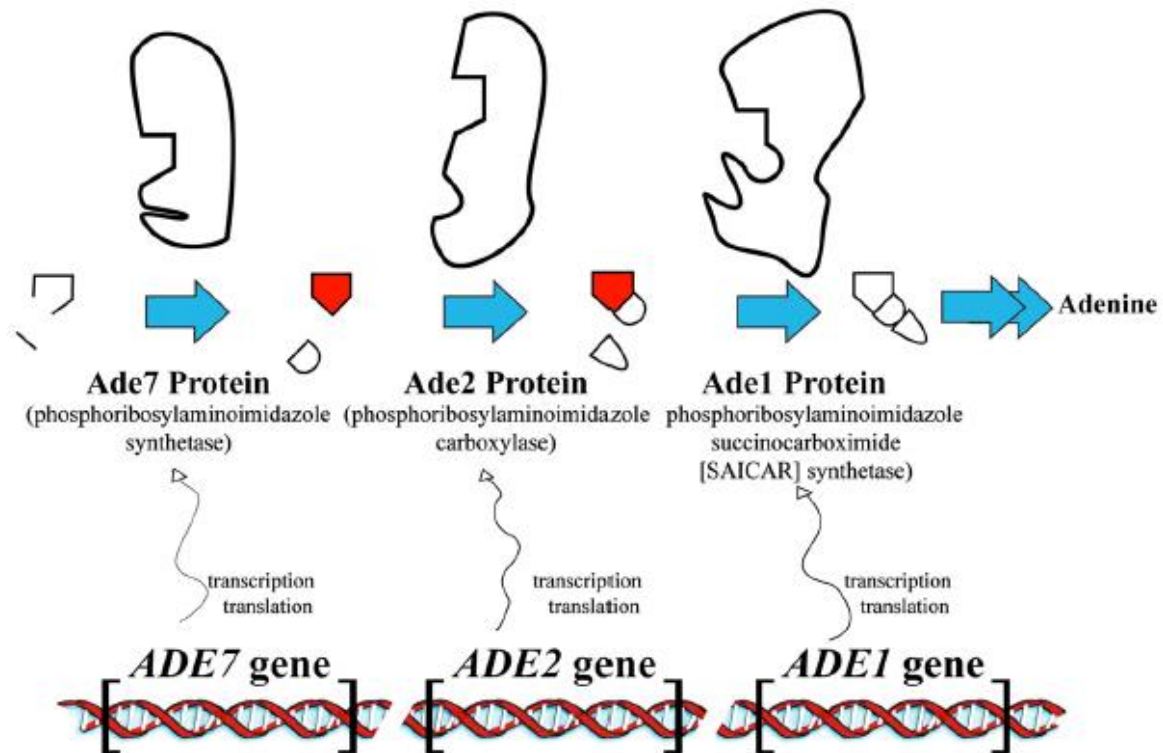






### Three steps in the making of adenine inside a yeast cell



**Legend-** these geometric shapes represent small chemicals that are added to or rearranged in the process of making adenine

-  Precursor (colorless)
-  Intermediate #1 (red)  
(Phosphoribosylaminoimidazole)
-  Intermediate #2 (red)  
(Phosphoribosylaminoimidazole carboxylate)
-  Intermediate #3 (colorless)  
(Phosphoribosylaminoimidazole-succinocarboxamide)

#### Points of Note

- (1) The genes were numbered in the order of their discovery. They are not adjacent to one another.
- (2) The gene encodes the instructions to make the corresponding protein (enzyme).
- (3) The enzyme (shown as a large irregular shape) is required for the chemical reaction depicted.
- (4) A block at any step in the pathway will lead to the accumulation of the molecules just prior to the step that is blocked.
- (5) There are steps prior to the first one shown here and after the last one shown here. For simplicity these steps are not shown.

Schematic of a portion of adenine biosynthesis. In a series of steps, only three of which are shown, intermediates, depicted as small shapes, are converted by enzymes, shown as larger shapes, to form adenine. The figure indicates that these enzymes arise from transcription and translation of corresponding genes that are dispersed in the genome. Upon amutation of the *ADE1* or *ADE2* genes that causes the encoded enzyme to be nonfunctional, the intermediate

before that step of the pathway accumulates, and adenine is not formed. As indicated by the red color, when intermediates AIR and CAIR accumulate, AIR is converted to a red polymer that colors the yeast colonies pinkish red. Intermediates and enzymes in this pathway have several alternative names, which can prove confusing to students and instructors. Some of these are as follows: intermediate 1, AIR or 1-(5-phosphoribosyl)-5-aminoimidazole or 5-phosphoribosylaminoimidazole; intermediate 2, CAIR or 5-P-ribosyl-4-carboxy-5-aminoimidazole or 5-phosphoribosylaminoimidazole carboxylate; and intermediate 3, *N*-succinyl-5-aminoimidazole-4-carboxamide ribotide (SAICAR) or 5-P-ribosyl-4-*N*-succinocarboximide-5-aminoimidazole or 5-phosphoribosylaminoimidazole succinocarboxamide. Thus, the Ade2 protein is also called AIR carboxylase and the Ade1 protein is called SAICAR synthetase. One should also note that in humans these two functions are found in a single bifunctional enzyme, so the human gene *PAICS* is listed as encoding both phosphoribosylaminoimidazole carboxylase and phosphoribosylaminoimidazole succinocarboxamide synthetase. Students received two versions of the figure; in the first version the three genes and their encoded enzymes are referred to generically as A, B, and C to avoid confusion about the nonsequential gene numbering while the students formulated ideas about the genesis of the red pigmentation. The figure shown here is the second version, modified slightly for improved clarity. In this second version, the actual names of the genes and proteins are used, with the exception of *ADE5,7*. This gene encodes a bifunctional enzyme that operates at two distinct steps of the pathway, only one of which (the Ade7 step) is shown here. Thus, for simplicity we refer to this gene and protein as *ADE7* and Ade7 in the figure. The enzymes have several different names; we chose to use the simplest name or the name(s) that students would encounter during the project.