* Basic Single Motif Grammar: Rule: S → N\*[TF]N\* Example: AATTC[GATA1]GGTCA
* Fixed-Space Two-Motif Grammar: Rule: S → N\*[TF1]N^k[TF2]N\* Example: AATT[AP1]NNNNNN[GR]GGTCA
* Variable-Space Two-Motif Grammar: Rule: S → N\*[TF1]N\*[TF2]N\* Example: AATT[AP1]NNNNNN[GR]GGTCA or AATT[AP1][GR]GGTCA
* Or-Logic Grammar: Rule: S → N\*([TF1]|[TF2])N\* Example: AATTC[GATA1]GGTCA or AATTC[TAL1]GGTCA
* Repetitive Motif Grammar: Rule: S → N\*([TF]N\*)\* Example: AATT[CTCF]NNN[CTCF]NNNNN[CTCF]GGTCA
* Palindromic Motif Grammar: Rule: S → N\*[TF]N\*[TF\_reverse]N\* Example: AATT[GATA→]NNNN[←ATAG]GGTCA
* Ordered Multi-Motif Grammar: Rule: S → N\*[TF1]N\*[TF2]N\*[TF3]N\* Example: AATT[GATA1]NNNN[TAL1]NNNNNNNN[RUNX1]GGTCA
* Alternating Motif Grammar: Rule: S → N\*([TF1]N\*[TF2]N\*)\* Example: AATT[DORSAL]NNN[SNAIL]NNNNN[DORSAL]NNN[SNAIL]GGTCA
* Nested Motif Grammar: Rule: S → N\*[TF1]N*S[TF1]N* Example: AATT[CTCF]NNN[GATA1]NNN[GATA1]NNN[CTCF]GGTCA
* Complex Multi-Motif Grammar: Rule: S → N\*([TF1]N\*[TF2]N\*|[TF3]N\*[TF4]N\*)*([TF5]|[TF6])N* Example: AATT[PU1]NN[IRF8]NNN[GATA1]NNNN[TAL1]NN[OCT4]GGTCA

In enhancer biology, various motif grammars help describe the arrangement and interaction of transcription factor (TF) binding sites. The simplest form is the **Single Motif Grammar**, which features a single TF binding site. Expanding on this, the **Fixed-Space Two-Motif Grammar** represents cooperative interactions between two TFs with a fixed distance between them, while the **Variable-Space Two-Motif Grammar** allows for flexible spacing, which is common in enhancers. The **Or-Logic Grammar** models enhancers that can be activated by either of two different TFs. For repetitive structures, the **Repetitive Motif Grammar** captures homotypic clusters of TF binding sites, frequently seen in enhancer regions. Some TF binding sites occur in **palindromic orientations**, especially with nuclear receptors, represented by the **Palindromic Motif Grammar**. More complex arrangements include the **Ordered Multi-Motif Grammar**, where multiple TFs bind in a specific sequence, and the **Alternating Motif Grammar**, which involves a repeating pattern of different TF binding sites. The **Nested Motif Grammar** is used for more intricate enhancers where one TF’s binding site flanks another, and the **Complex Multi-Motif Grammar** represents highly complex enhancers with multiple TFs and variable spacing. The TF motifs chosen for these grammars span a wide range of biological processes: **GATA1, TAL1, RUNX1** are involved in blood cell development, **AP1 and GR** in stress response, **CTCF** in chromatin organization, and **PU1, IRF8** in immune development. Other important TFs include **OCT4** for stem cell pluripotency, **ETS** for cell proliferation, **SREBP** for lipid metabolism, **CREB** for cAMP responses, **STAT** for cytokine signaling, and **DREF, TRL, E2F** for chromatin remodeling and cell cycle regulation, especially in *Drosophila*.