

- Mark (T)rue or (F)alse (1 point each)

1. Compared to other nuclear genes, ribosomal genes differ in their base compositions. (T)
2. The catalytic center of polymerase II contains Na⁺ ions. (F)
3. Enhancers and repressors can be tissue-specific based on the types of DNA-binding proteins that are present. (T)
4. The product of the *RPB1* gene in yeast assists polymerase IIA in binding DNA. (T)
5. Based on experimental evidence, RNA polymerase II binds to a region extending from -64 to +74. (F)
6. The carboxyl-terminal domain of polymerase is phosphorylated prior to the formation of initiation complex. (F)
7. At least eight TAF_{II}s are associated with TFIID. (T)

- Fill the blank using example (1 point for each blank). There might be duplicated answers.

TFIIA, TFIIB, TFIIC, TFIID, TFIIIE, TFIIF, TFIIH, TFIIS, TFIIIA, TFIIB, TFIIC, TAFII250, TAFII150, TAFII110, Sp1, Rpb1, Rpb2, Rpb3, Rpb5, Rpb4/7, TBP, TRF1

8. (TFIIB) binds to TBP and TATA box via its C-terminal domain.
9. (TAF_{II}250) and (TAF_{II}150) help TFIID bind to the initiator and DPEs of promoters and therefore can enable TBP to bind to TATA-less promoters.
10. (TFIIS) stimulates proofreading presumably by stimulating the RNase activity of RNA polymerase.
11. (TFIIB) N-terminal domain lies close to the RNA polymerase II active center, and to the largest subunit of (TFIIF), in the preinitiation complex.
12. (TFIIH) phosphorylates the CTD of the largest RNA polymerase II subunit, creating the phosphorylated form of the enzyme (IIO). (TFIIIE) greatly stimulates this process in vitro.
13. (TFIIIE) and (TFIIH) are not essential for formation of an open promoter complex, or for elongation, but they are required for promoter clearance. (TFIIH) has a DNA helicase activity that is essential for transcription.
14. (TFIIS) stimulates elongation by limiting arrest at discrete sites.
15. Transcription of all classical class III genes requires (TFIIB) and (TFIIC), and transcription of the 5S rRNA genes requires these two plus (TFIIIA)

- Give a short answer

16. Categorize cellular RNAs synthesized by RNA polymerase I, II, and III (3 points)

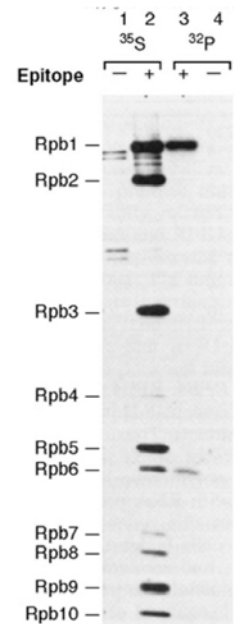
RNA pol I – large rRNAs, polII – hnRNAs, snRNAs, polIII – 5S rRNA, tRNA, U6 snRNA, 7SL, 7SK RNAs

17. Richard Young and colleagues used 'epitope tagging' method to identify the subunits of RNA polymerase II. In this study (see Fig 1.), they labeled proteins with ^{35}S or ^{32}P . What could they know from these tagged proteins labeled with two different radioisotopes? (4 points)

^{35}S - good estimate of the stoichiometrics of subunits

^{32}P - phosphorylated subunits

Fig. 1.



18. Class II promoters may contain up to five conserved elements: a core promoter composed of four elements and an upstream promoter element. What are four core promoter elements? (4 points)

BRE, TATA, Inr, DPE

19. RNA polymerase III transcribes a set of short genes (Class III genes). Among them, what are the classical Class III genes? (2 points)

5S rRNA, tRNA (types I and II)

20. Explain the fact that enhancer activity is tissue-specific. (3 points)

Enhancers rely on "tissue-specific DNA-binding proteins" for their activities.

21. Present a hypothesis that explains the fact that substitution of dCs for dTs and dIs for dAs, in the TATA box (making a CICI box) has no effect on TFIID binding (TATA box binding protein). Provide the rationale for your hypothesis (5 points)

TBP binds in minor groove of TATA box.

"CICI" substitution remained the minor groove unaltered.

22. TFIID contains at least eight TAF_{II}s, in addition to TBP. The TAF_{II}s serve several functions. Among them, list two obvious ones. (4 points)

1. interacting with core promoter elements

2. interacting with activators

23. List in order six general transcription factors to form a class II preinitiation complex in vitro. (3 points)

TFIID+TFIIA -> TFIIIB -> TFIIF+RNA pol -> TFIIH+TFIIE

24. Class I promoters are recognized by two transcription factors. What are they? (2 points)

a core binding factor and a UPE binding factor

25. Model of preinitiation complexes on TATA-less promoters recognized by all three polymerases (Fig. 2).

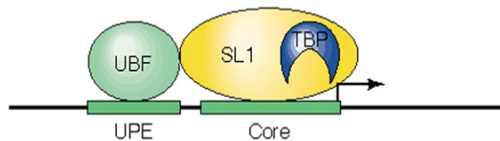
Identify the assembly factors in each case of Fig. 2. (3 points)

Assembly factors are all in green. Check Fig. 11-42 in your textbook.

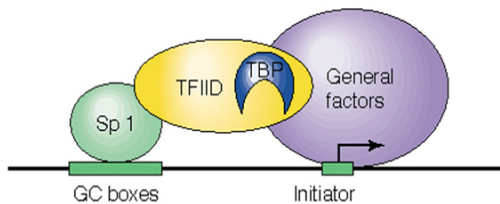
Fig. 2

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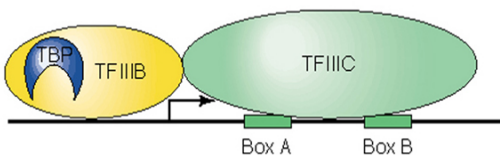
Class I
rRNA



Class II
G₆I



Class III
VA₁



(Source: Reprinted from White, R.J. and S.P. Jackson, mechanism of TATA-binding protein recruitment to a TATA-less class III promoter. Cell 71:1051, 1992. Copyright © 1992, with permission from Elsevier Science.)