

CAMPBELL **BIOLOGY IN FOCUS**

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15

Messenger RNA Degradation

Lecture Presentations by
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mRNA Degradation

- The life span of mRNA molecules in the cytoplasm is important in determining the pattern of protein synthesis in a cell
- Eukaryotic mRNA generally survives longer than prokaryotic mRNA
- Nucleotide sequences that influence the life span of mRNA in eukaryotes reside in the untranslated region (UTR) at the 3' end of the molecule

Initiation of Translation

- The initiation of translation of selected mRNAs can be blocked by regulatory proteins that bind to sequences or structures of the mRNA
- Alternatively, translation of all mRNAs in a cell may be regulated simultaneously
- For example, translation initiation factors are simultaneously activated in an egg following fertilization

Concept 15.3: Noncoding RNAs play multiple roles in controlling gene expression

- Only a small fraction of DNA encodes proteins, and a very small fraction of the non-protein-coding DNA consists of genes for RNA such as rRNA and tRNA
- A significant amount of the genome may be transcribed into noncoding RNAs (ncRNAs)
- Noncoding RNAs regulate gene expression at several points

Effects on mRNAs by MicroRNAs and Small Interfering RNAs

- **MicroRNAs (miRNAs)** are small single-stranded RNA molecules that can bind to complementary mRNA sequences
- These can degrade the mRNA or block its translation

Figure 15.UN03

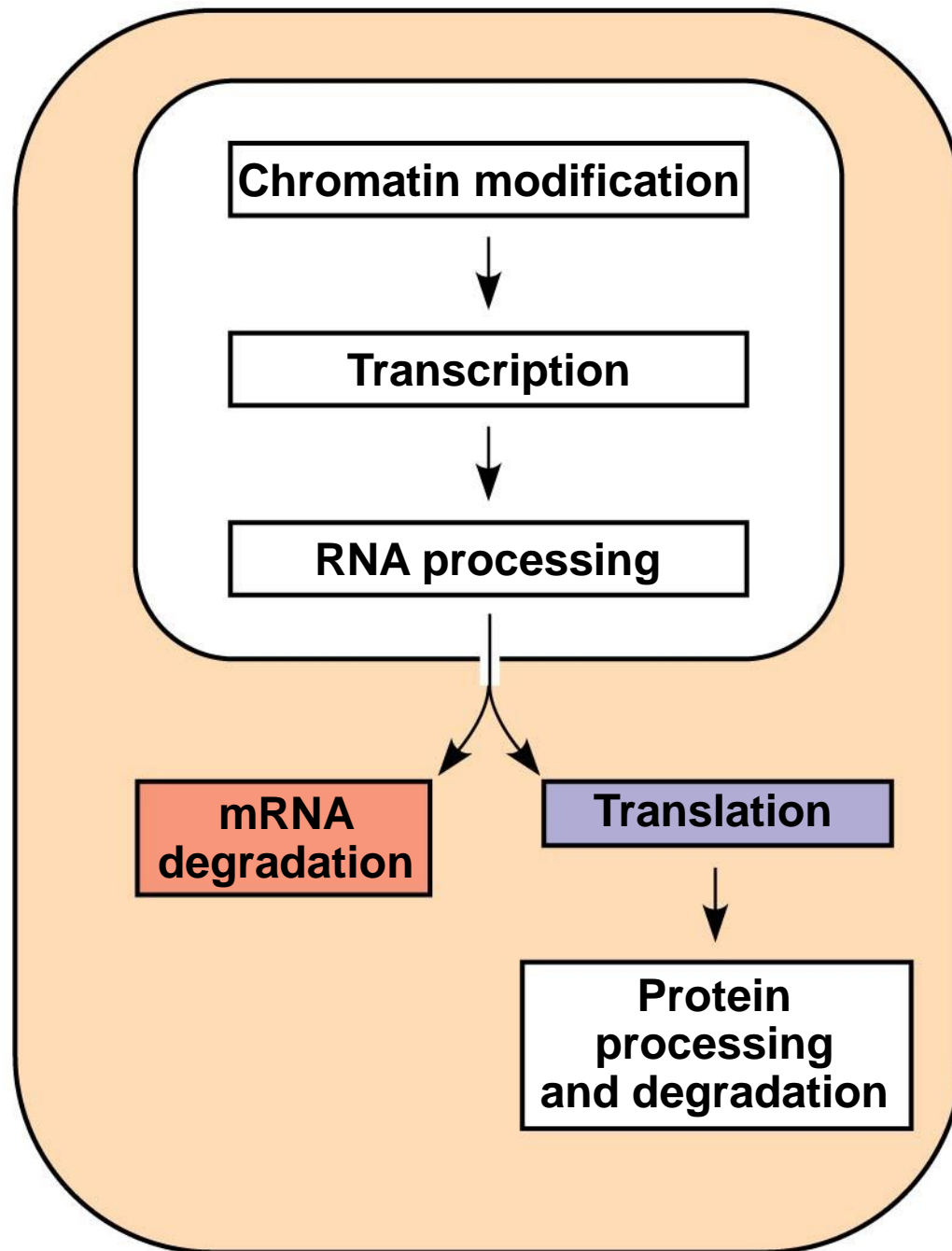
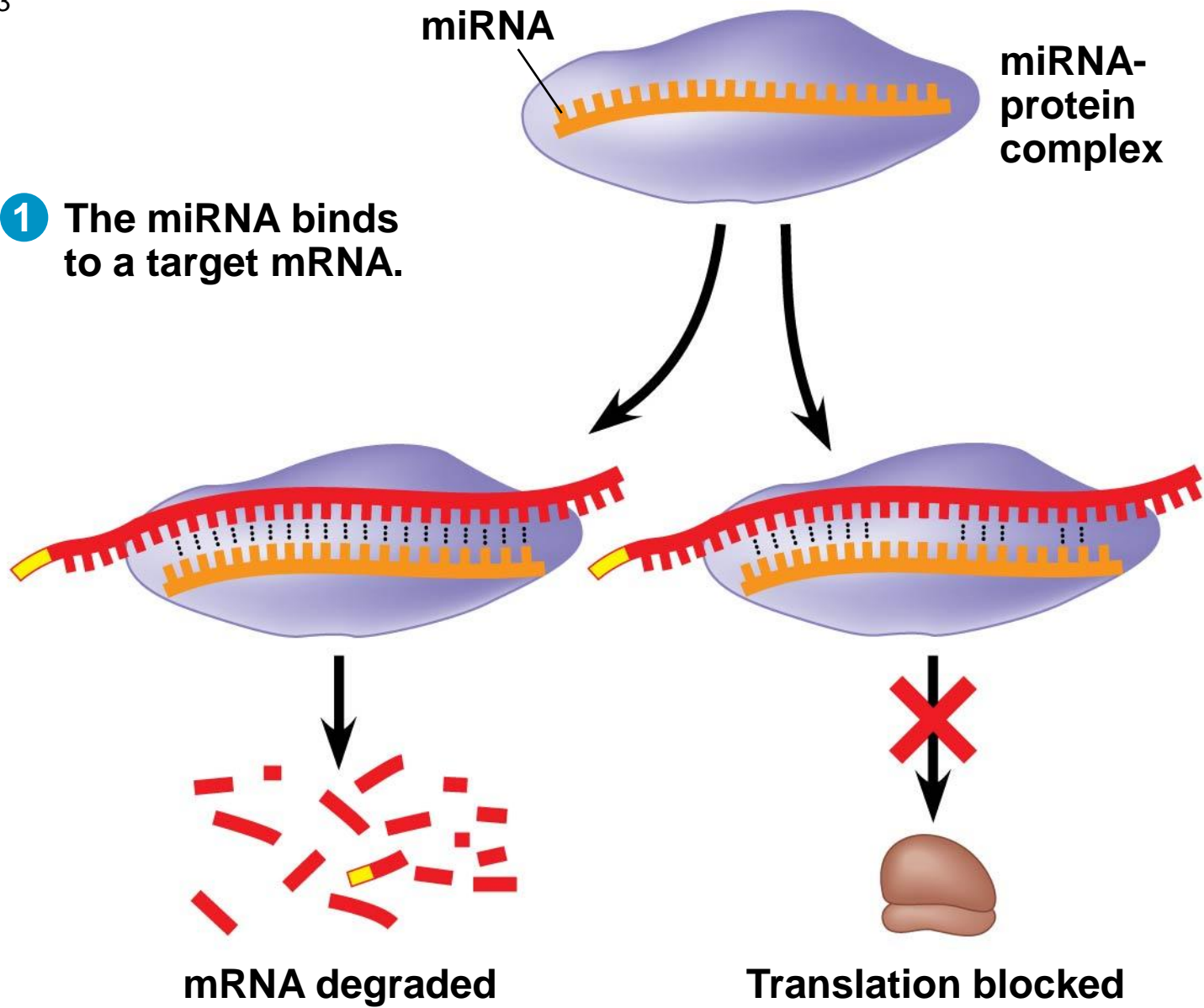


Figure 15.13

1 The miRNA binds to a target mRNA.



2 If bases are completely complementary, mRNA is degraded. If match is less than complete, translation is blocked.

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- Another class of small RNAs are called **small interfering RNAs (siRNAs)**
 - siRNAs and miRNAs are similar but form from different RNA precursors
 - The phenomenon of inhibition of gene expression by siRNAs is called **RNA interference (RNAi)**

Chromatin Remodeling and Effects on Transcription by ncRNAs

- In some yeasts RNA produced from centromeric DNA is copied into double-stranded RNA and then processed into siRNAs
- The siRNAs, together with a complex of proteins, act as a homing device to target transcripts being made from centromeric sequences
- Proteins in the complex then recruit enzymes that modify the chromatin to form the highly condensed heterochromatin found at the centromere

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- A class of small ncRNAs called piwi-associated RNAs (piRNAs) also induce formation of heterochromatin
 - They block expression of transposons, parasitic DNA elements in the genome
 - The role of ncRNAs adds to the complexity of the processes involved in regulation of gene expression