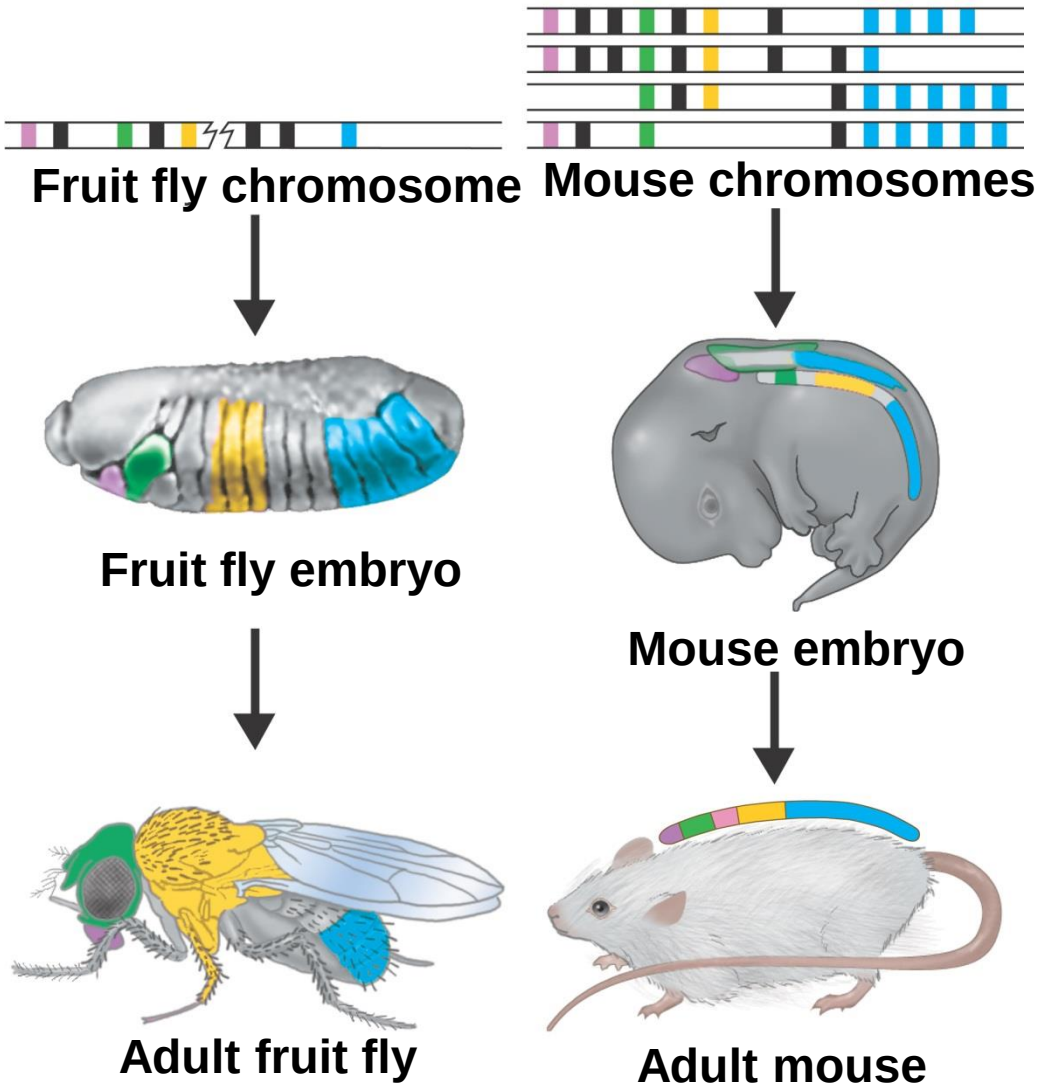
12-5 Gene Regulation



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Gene Regulation: An Example

E. coli provides an example of how gene expression can be regulated.

An **operon** is a group of genes that operate together.

In *E. coli*, these genes must be turned on so the bacterium can use lactose as food.

Therefore, they are called the *lac* operon.

The *lac* genes are turned off by repressors and turned on by the presence of lactose.

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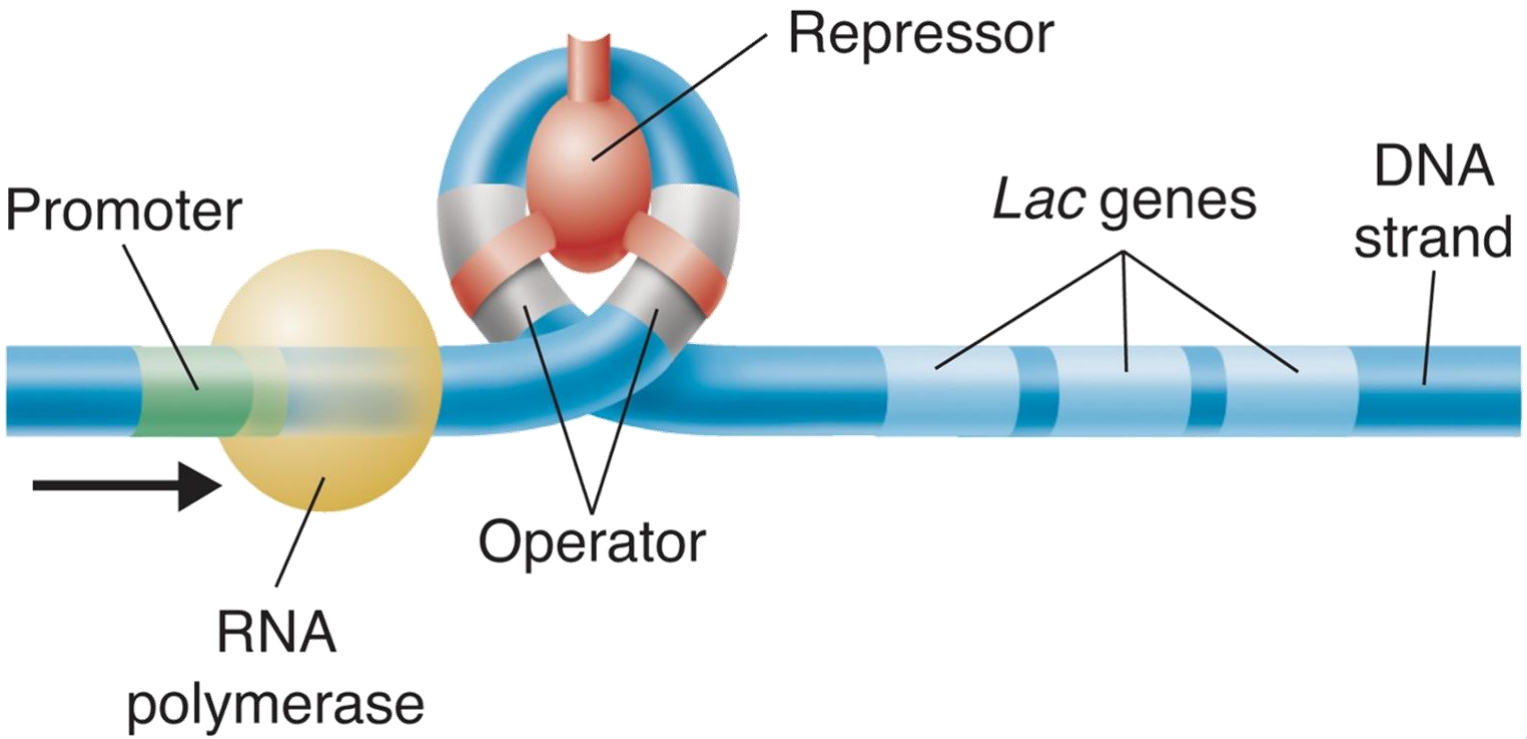
On one side of the operon's three genes are two regulatory regions.

- In the promoter (P) region, RNA polymerase binds and then begins transcription.



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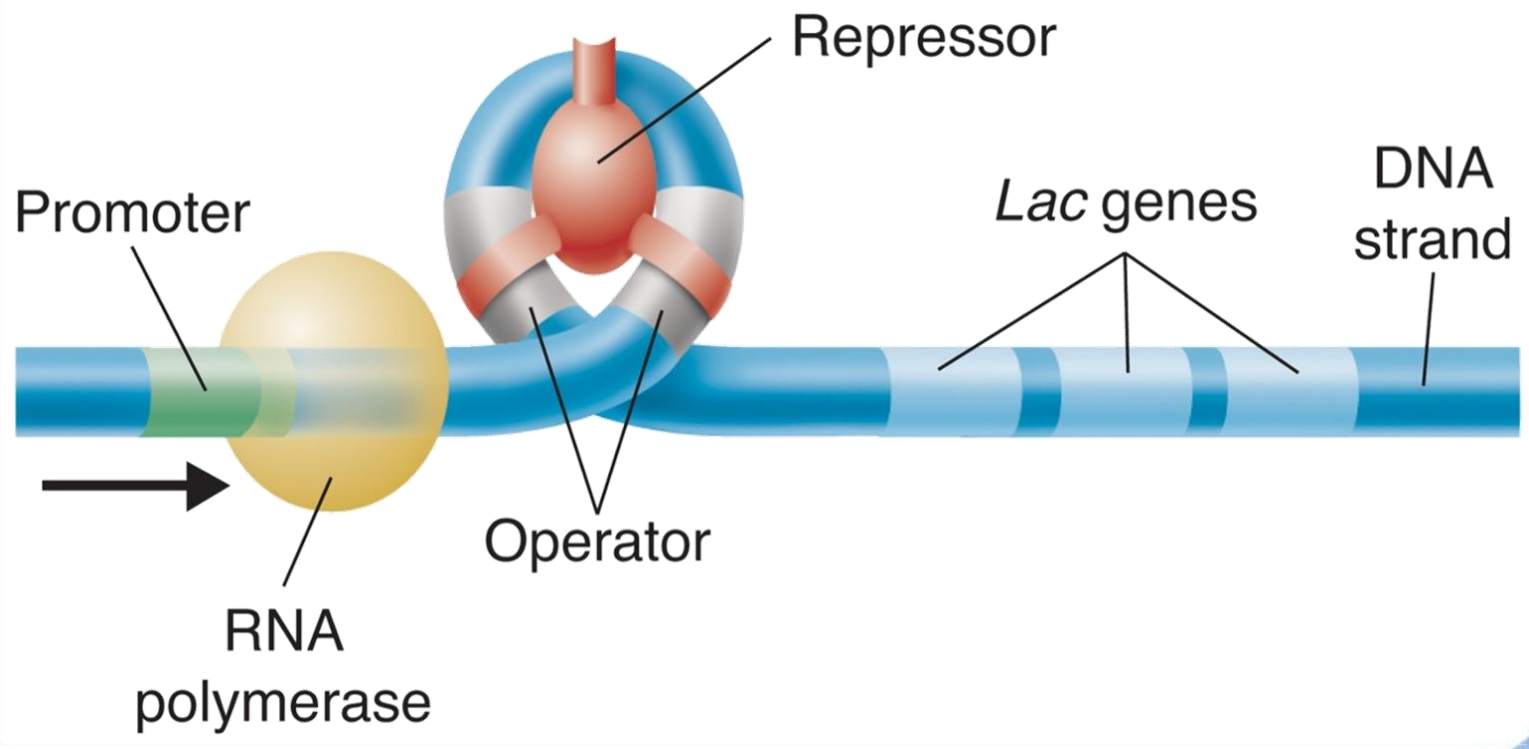
- The other region is the **operator** (O).

When the *lac* repressor binds to the O region, transcription is not possible.



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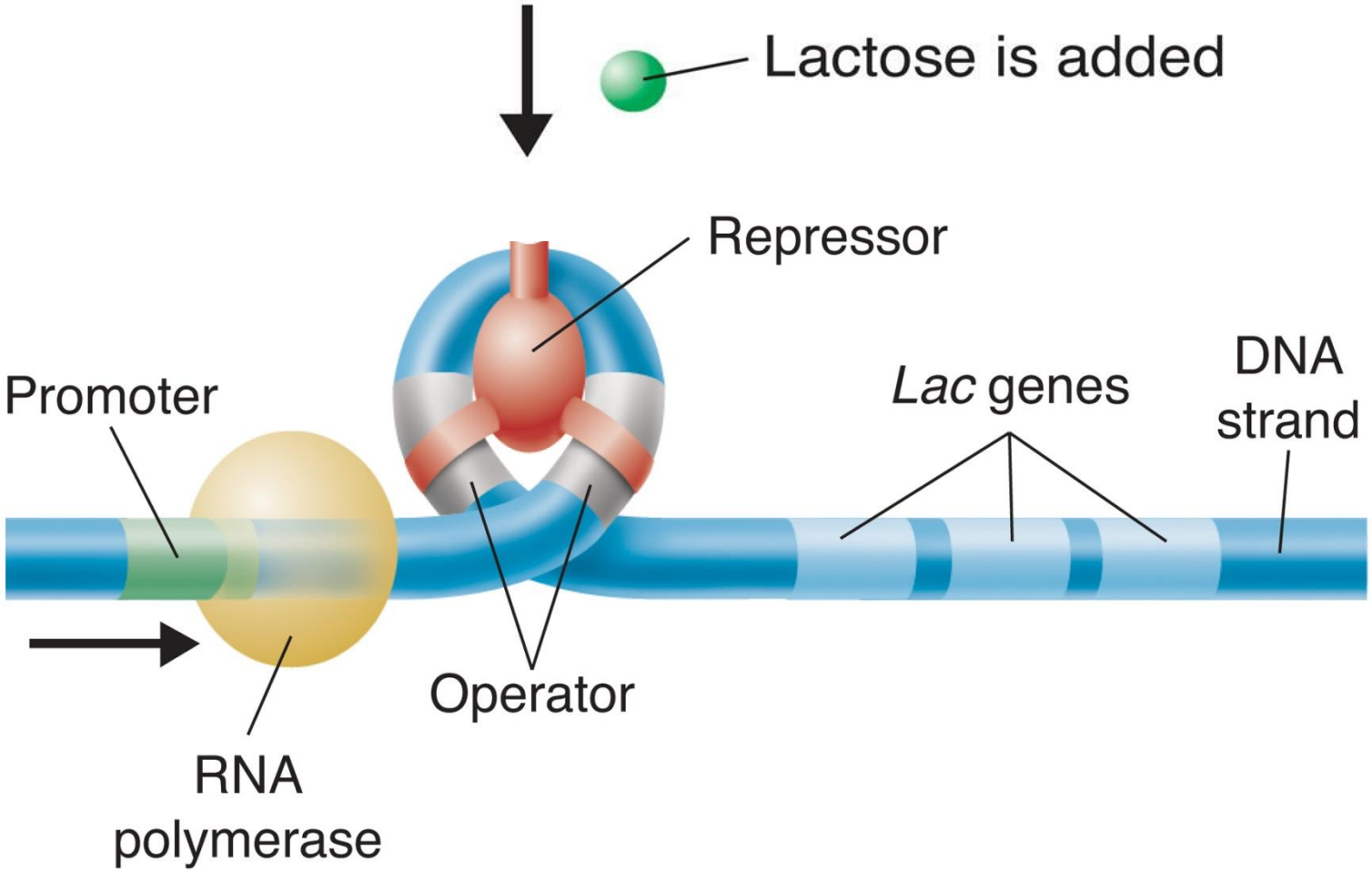
When lactose is added, sugar binds to the repressor proteins.



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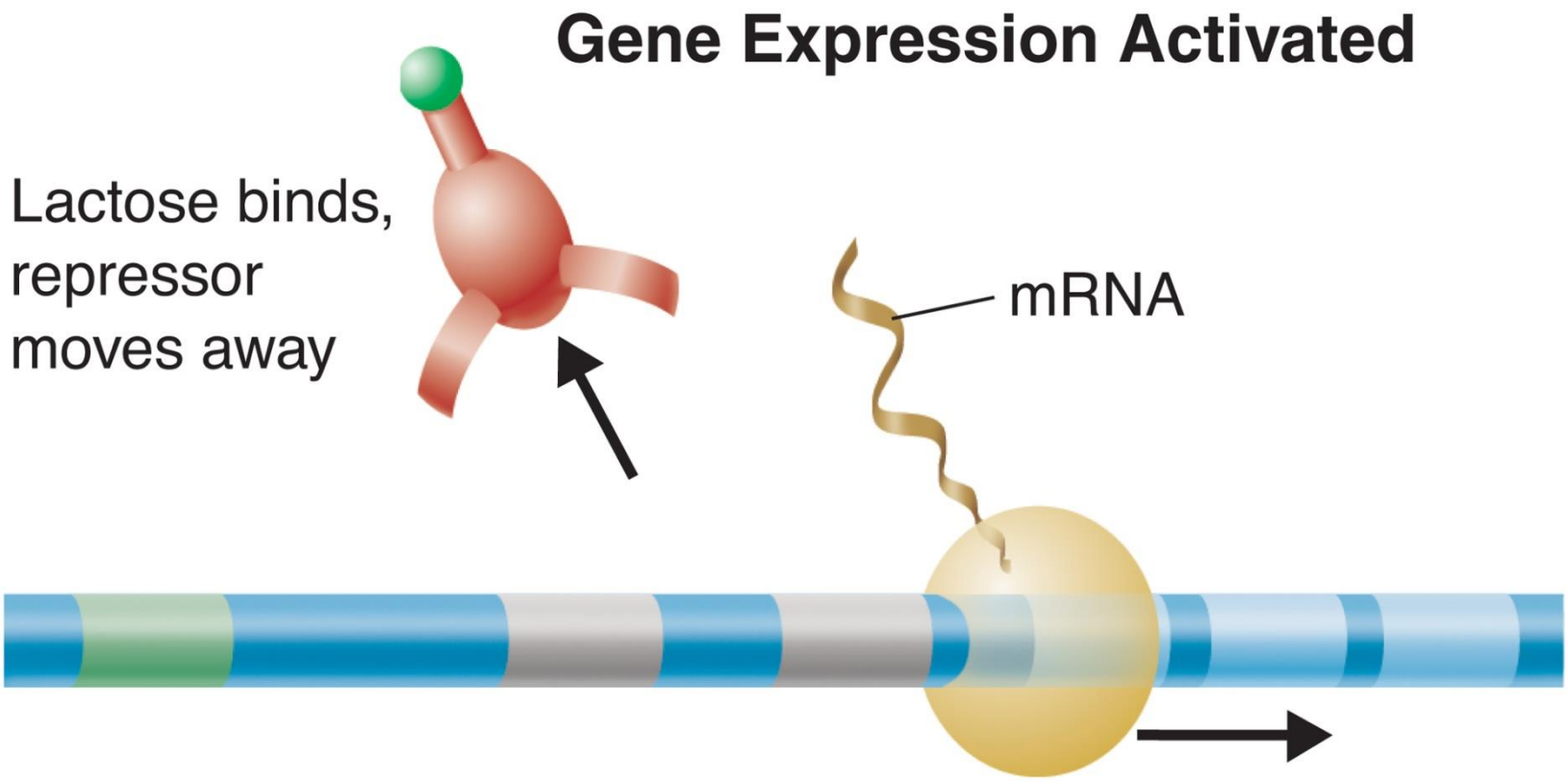
The repressor protein changes shape and falls off the operator and transcription is made possible.



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Many genes are regulated by repressor proteins.

Some genes use proteins that speed up transcription.

Sometimes regulation occurs at the level of protein synthesis.

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Eukaryotic Gene Regulation

Operons are generally not found in eukaryotes.

Most eukaryotic genes are controlled individually and have regulatory sequences that are much more complex than those of the *lac* operon.

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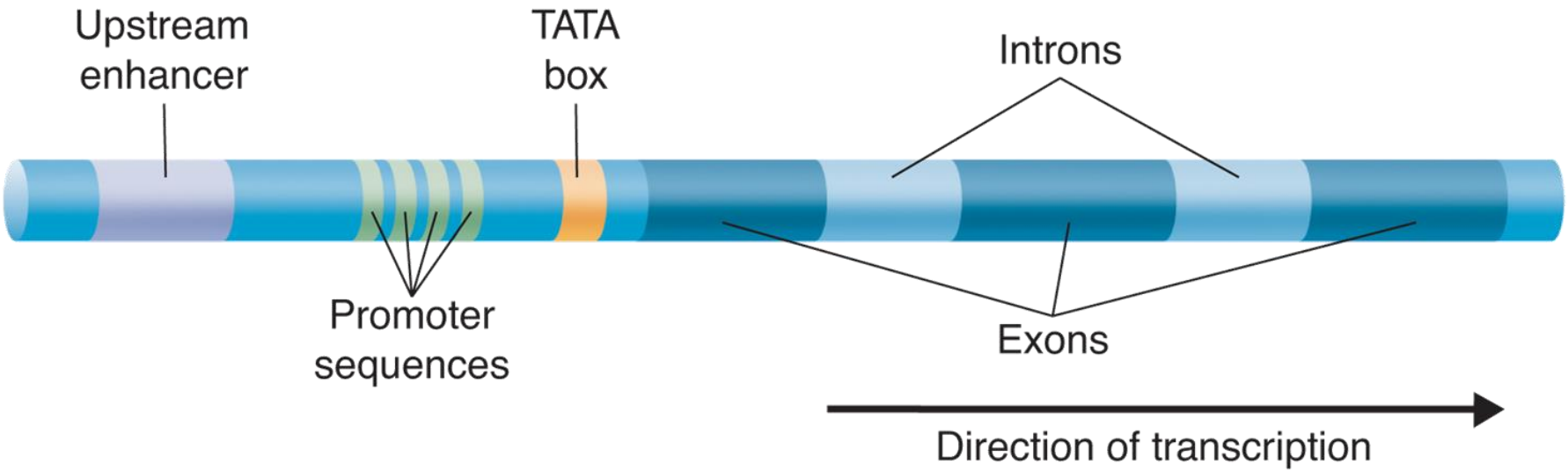
Many eukaryotic genes have a sequence called the TATA box.

The TATA box seems to help position RNA polymerase.



Eukaryotic promoters are usually found just before the TATA box, and consist of short DNA sequences.

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Genes are regulated in a variety of ways by enhancer sequences.

Many proteins can bind to different enhancer sequences.

Some DNA-binding proteins enhance transcription by:

- opening up tightly packed chromatin
- helping to attract RNA polymerase
- blocking access to genes

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Development and Differentiation

As cells grow and divide, they undergo **differentiation**, meaning they become specialized in structure and function.

Hox genes control the differentiation of cells and tissues in the embryo.

Careful control of expression in hox genes is essential for normal development.

All hox genes are descended from the genes of common ancestors.

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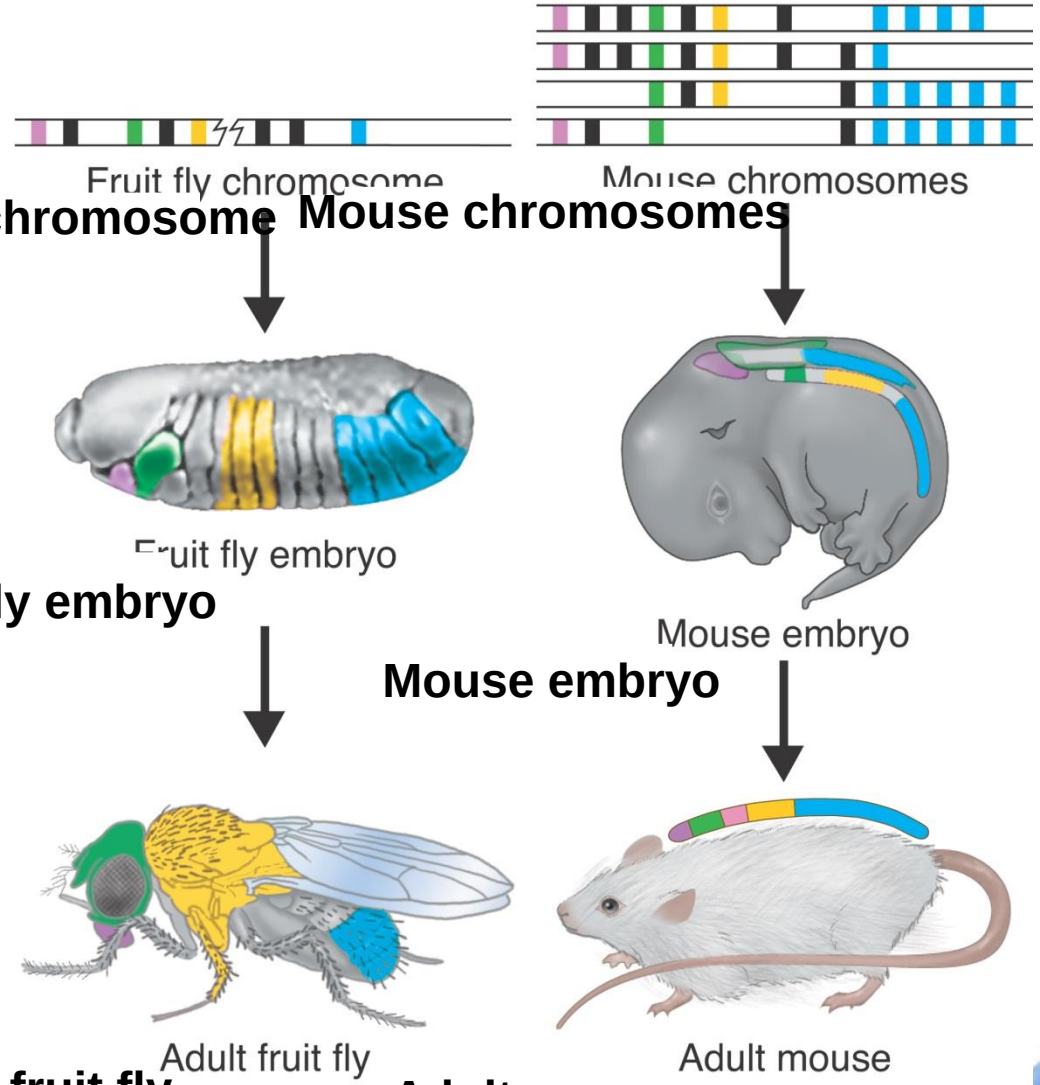
Hox Genes

Start Video @ 38:00



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1 Which sequence shows the typical organization of a single gene site on a DNA strand?

a. start codon, regulatory site, promoter, stop codon

b. regulatory site, promoter, start codon, stop codon

c. start codon, promoter, regulatory site, stop codon

d. promoter, regulatory site, start codon, stop codon

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2 A group of genes that operates together is a(an)

a. promoter.

b. operon.

c. operator.

d. intron.

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3 Repressors function to

a. turn genes off.

b. produce lactose.

c. turn genes on.

d. slow cell division.

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4 Which of the following is unique to the regulation of eukaryotic genes?

a. promoter sequences

b. TATA box

c. different start codons

d. regulatory proteins

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5 Organs and tissues that develop in various parts of embryos are controlled by

a. regulation sites.

b. RNA polymerase.

c. hox genes.

d. DNA polymerase.

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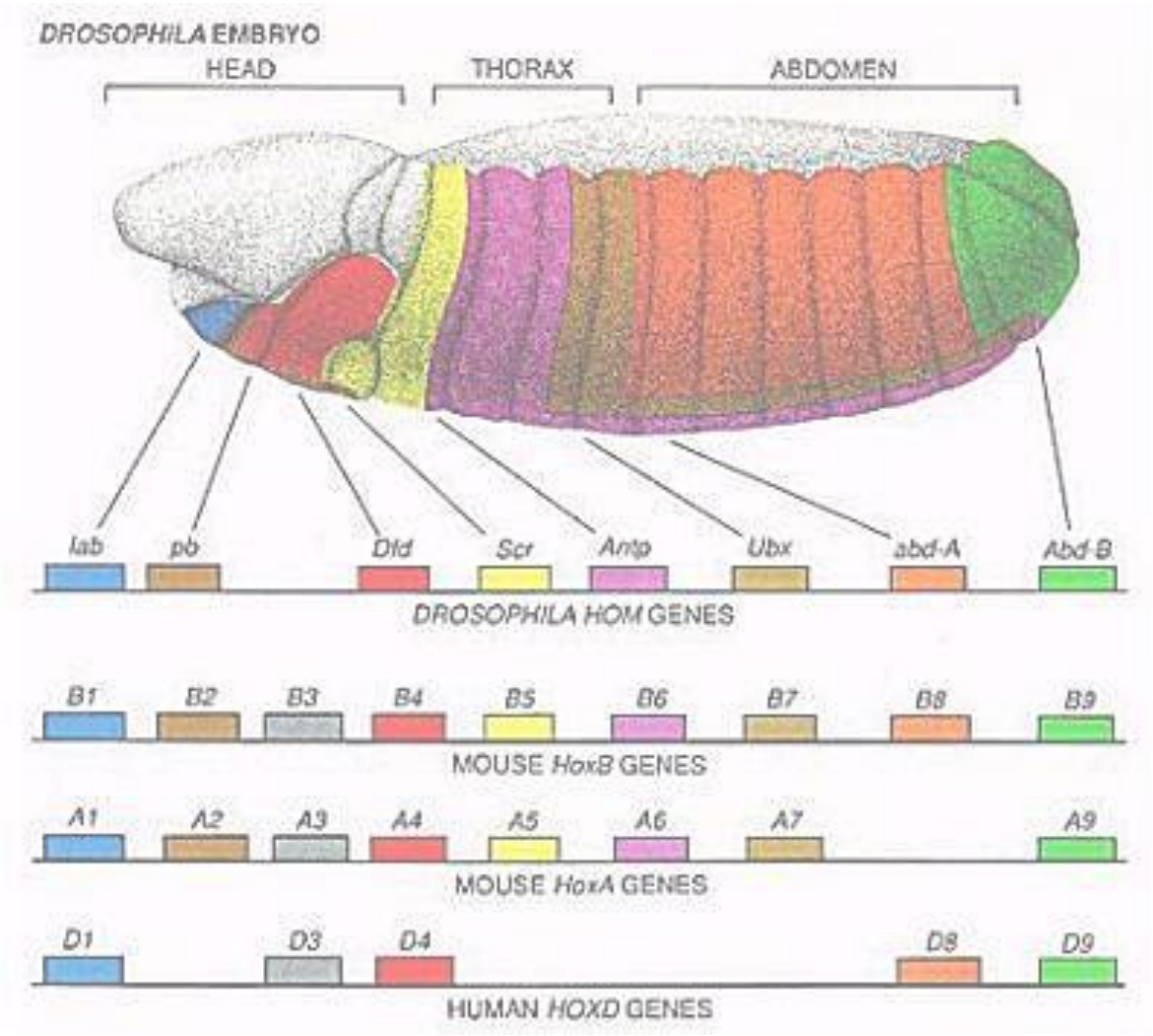

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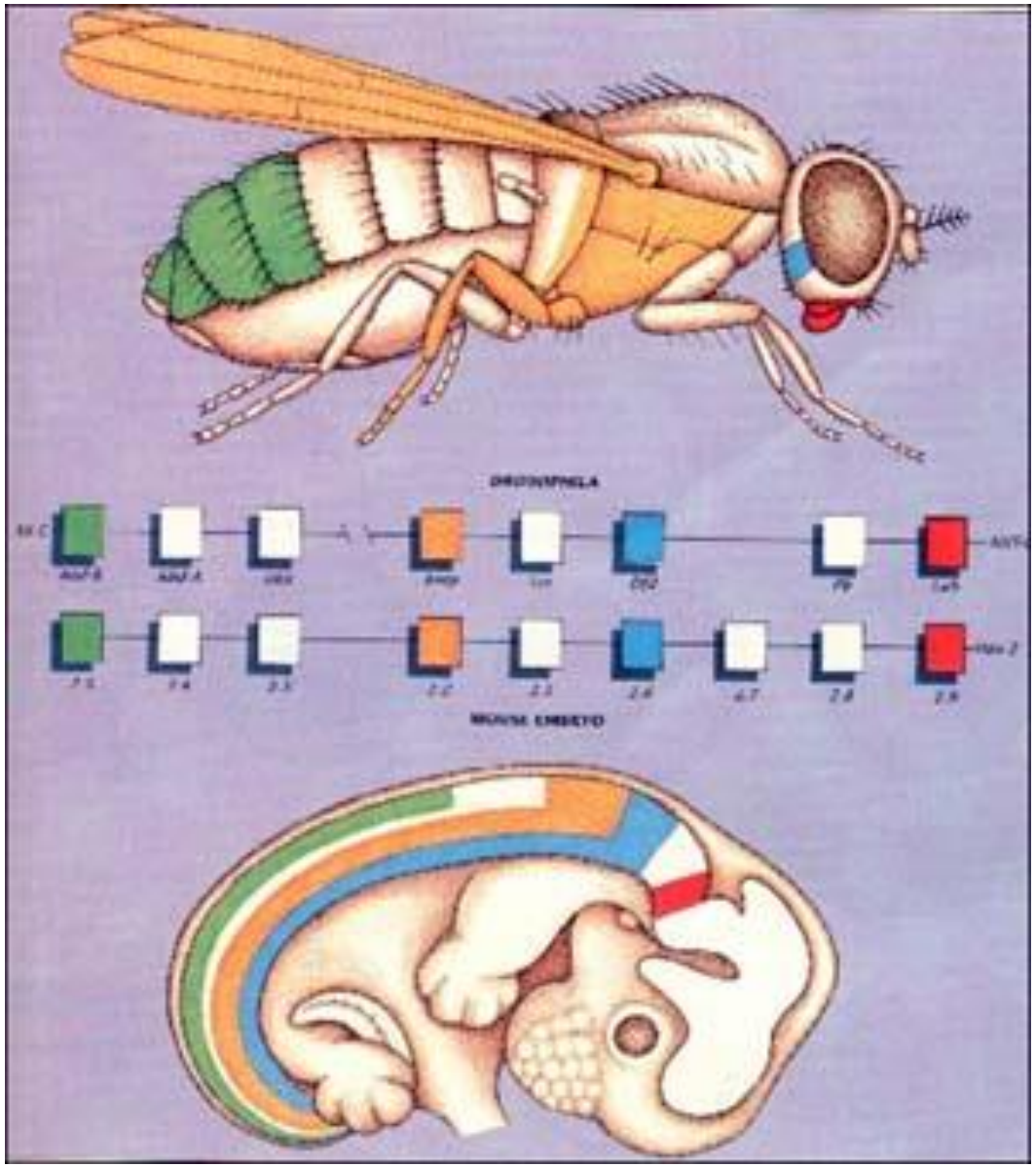

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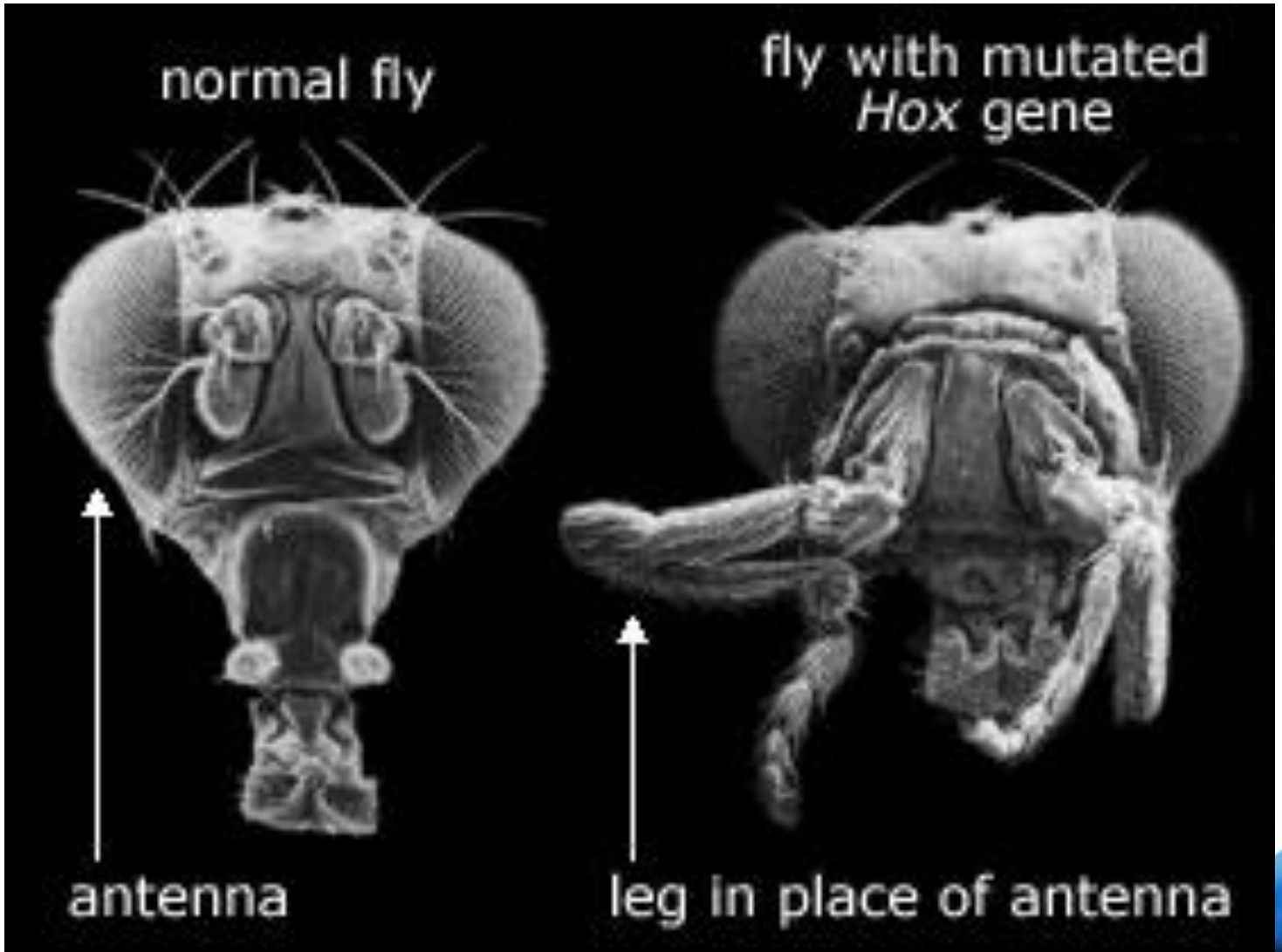

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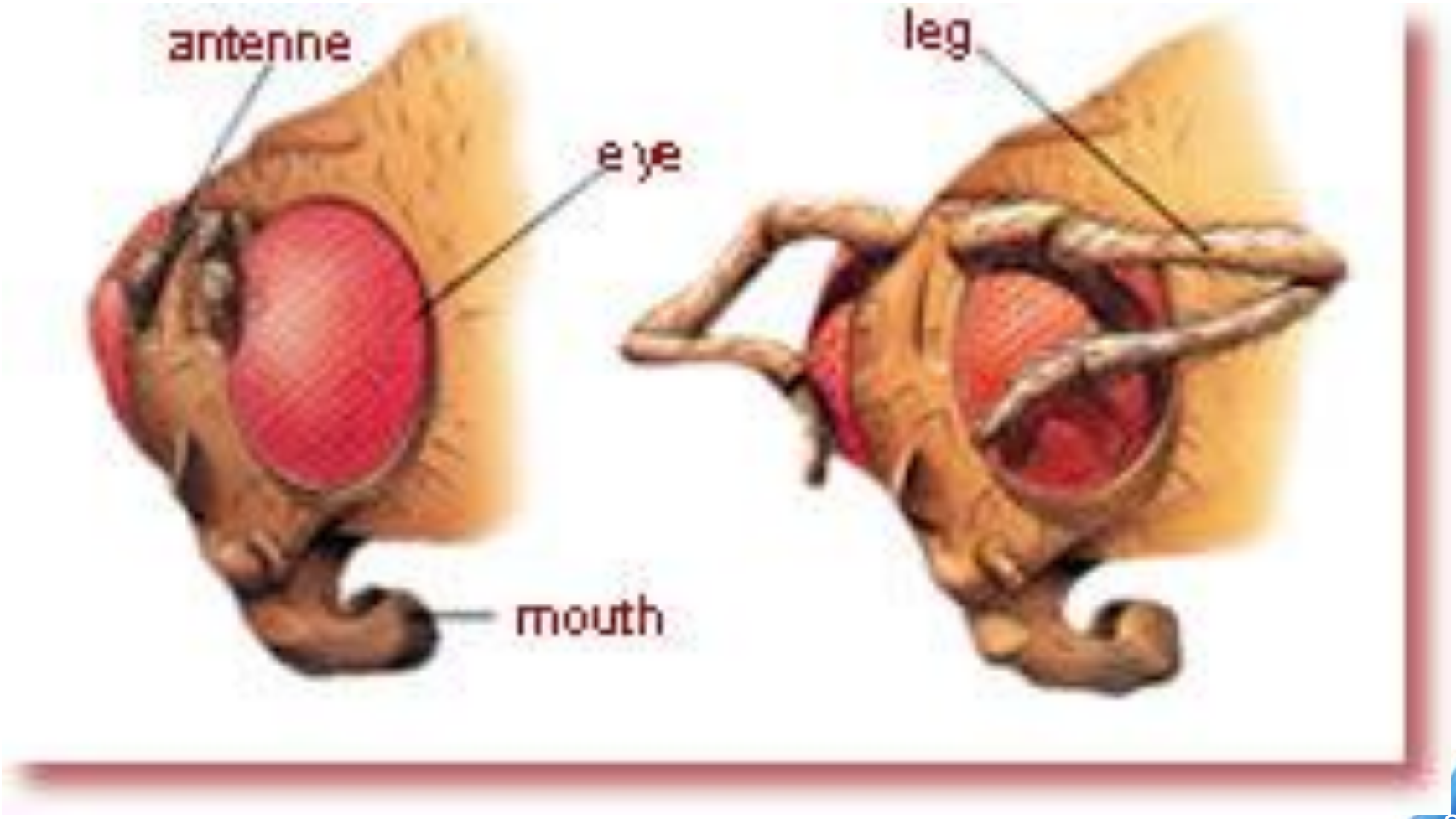

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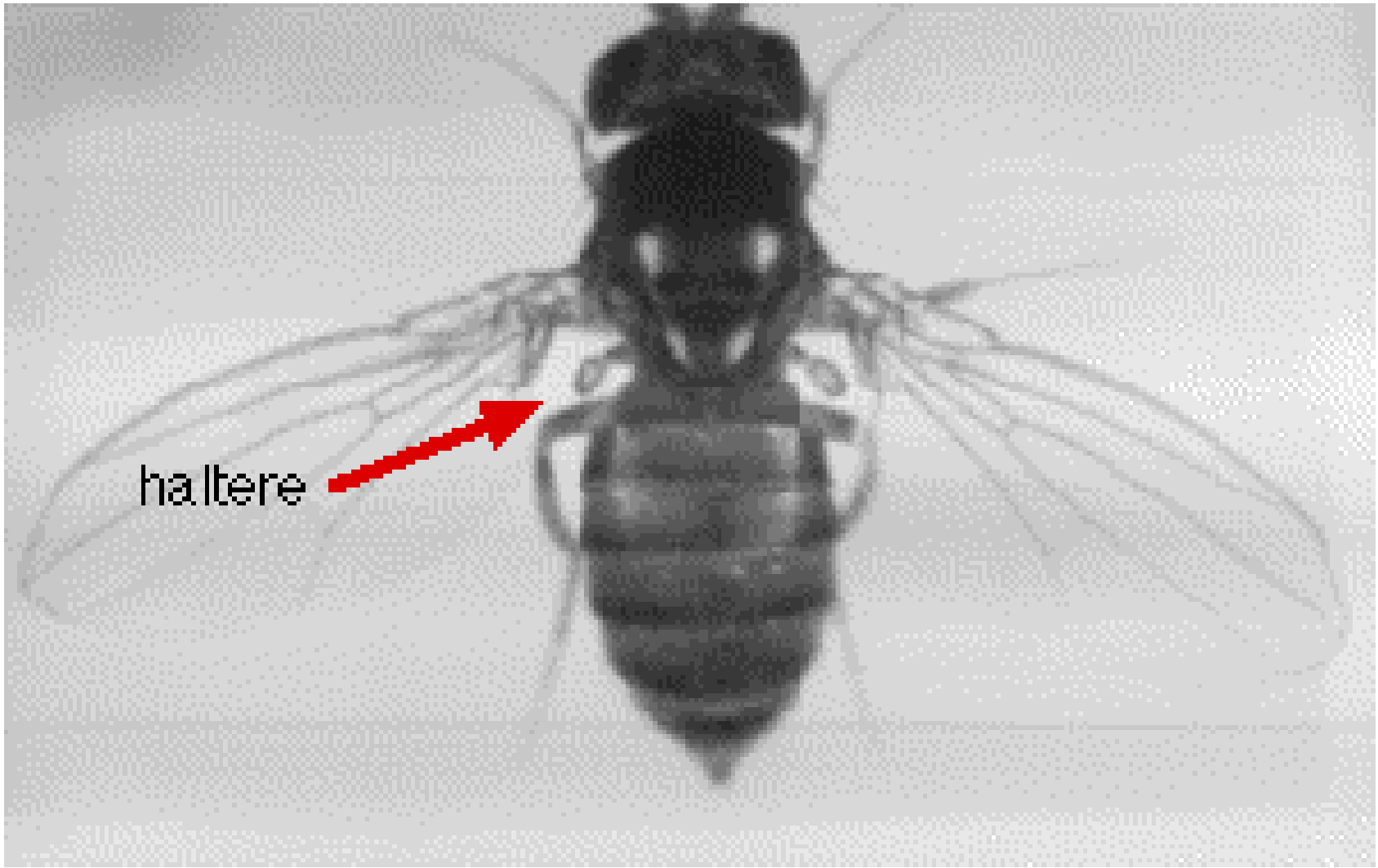

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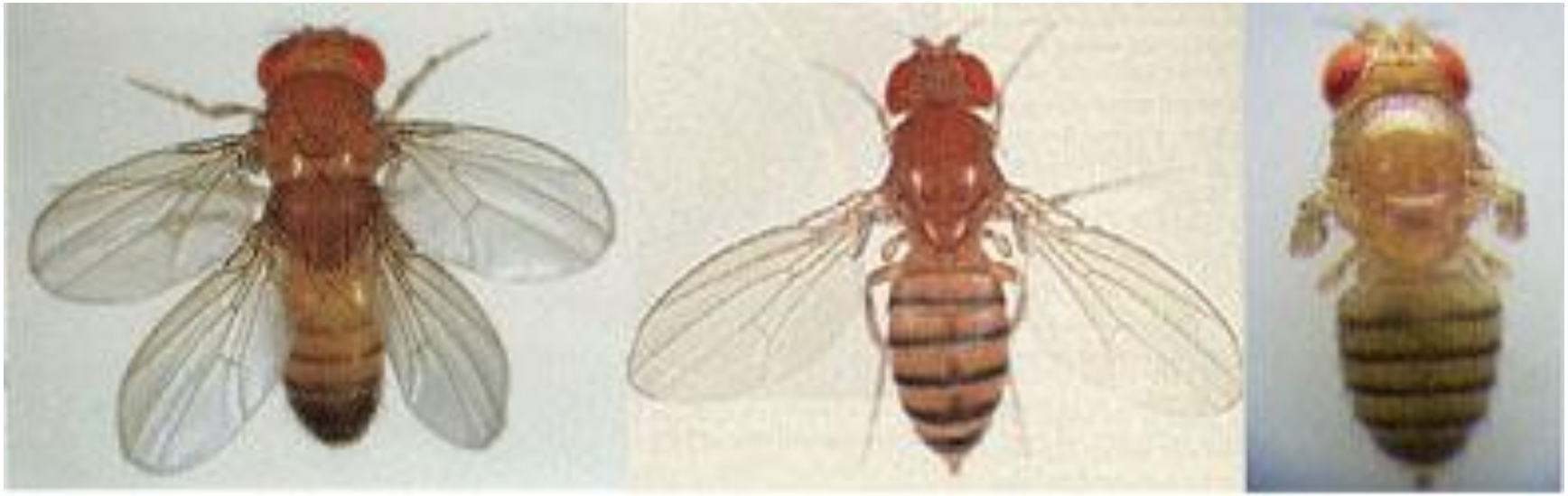

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