Introduction to Cell Biology
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Central Dogma: Transcription - Part 2

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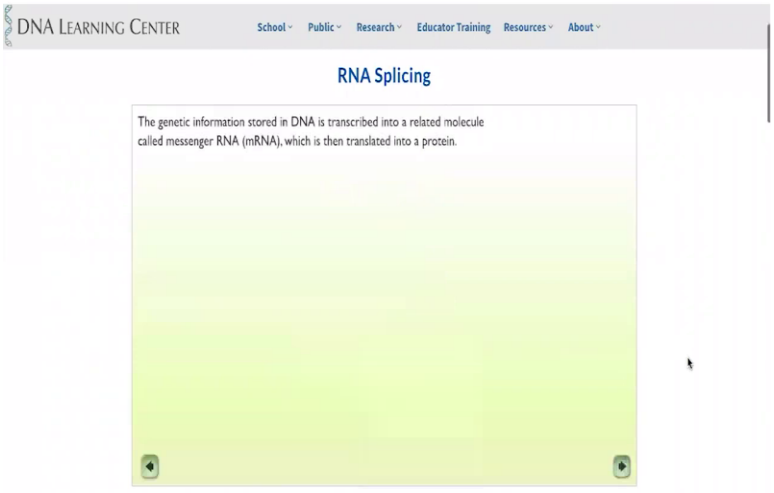

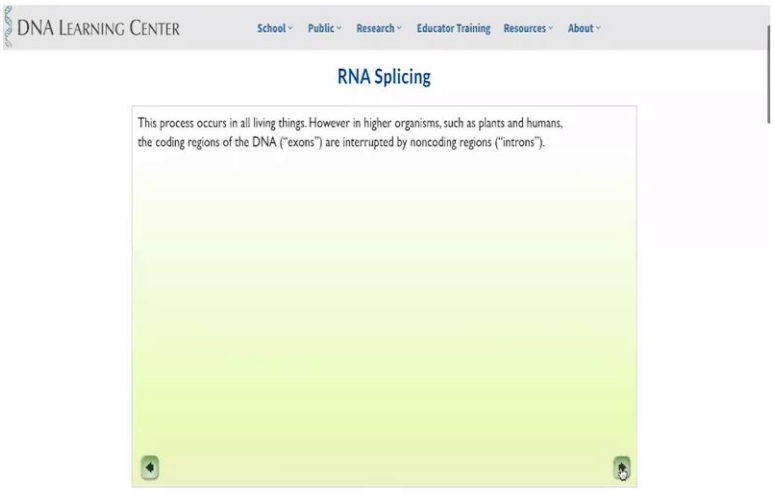

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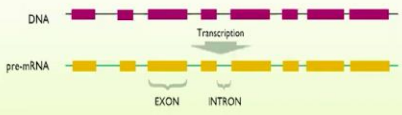
RNA Splicing

During transcription, the entire gene is copied into precursor mRNA (pre-mRNA), which includes exons and introns.



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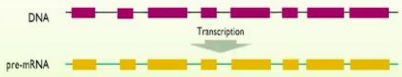
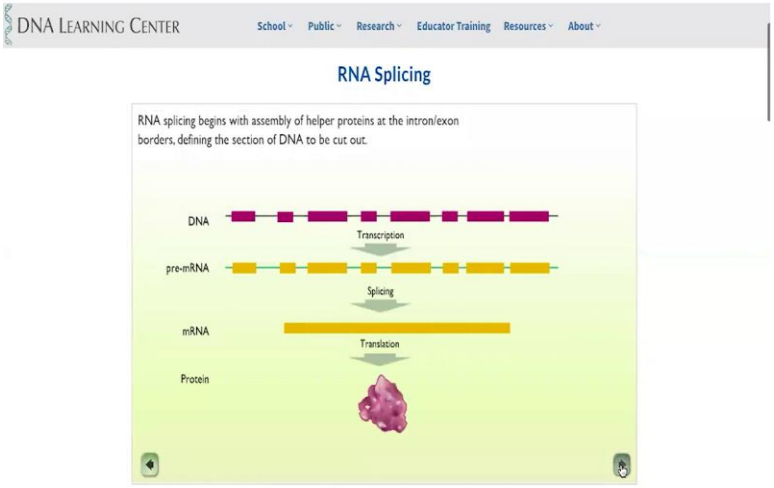
RNA Splicing

A process called RNA splicing then removes the introns, joining the exons into a contiguous sequence. This "mature" mRNA is ready to be translated into protein.





I will just go to the cold spring harbor website and show you in a stepwise manner what is splicing. So, please read things which are there on the screen. So, this talks to you about the basic process of transcription. It defines what are exons and what are introns. Showing you the similar kind of pictures which I have shown you that you start with DNA which has both introns and exons, a gene has introns and exons.

The pre-RNA will again be a faithful copy of one of the strands of DNA and it will contain all the information in the DNA. Now, some of this information is not particularly useful if you are making a protein so it is spliced out and the spliced mRNA is then translated into protein.

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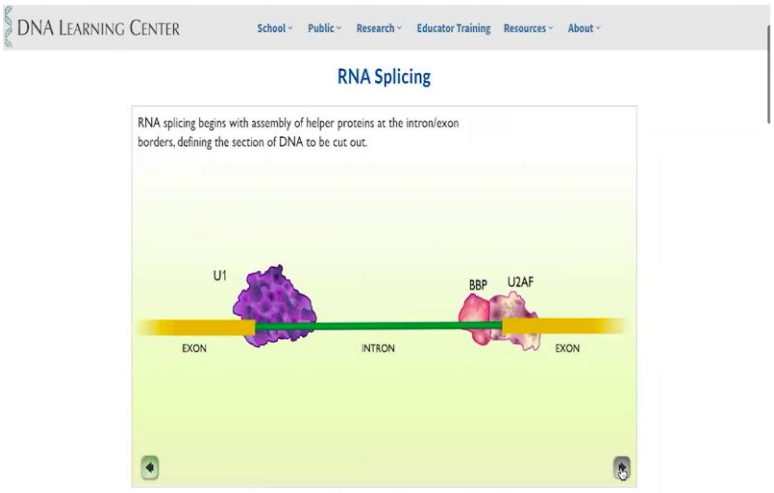

And now let us look at what are the splicing machinery. So, here is a zoomed picture of a piece of pre-mRNA with the exons in yellow orangish and the introns in green and there is a mechanism to edit this piece of RNA so that the introns which do not contain useful information are removed and the exons are put together.

You will notice that there are these enzymes called U1, BBP, U2AF, which are sitting at the intron exon junctions. Now, some of these, U1 for example are actually RNA based enzymes and not protein based enzymes. Let us see the next step.

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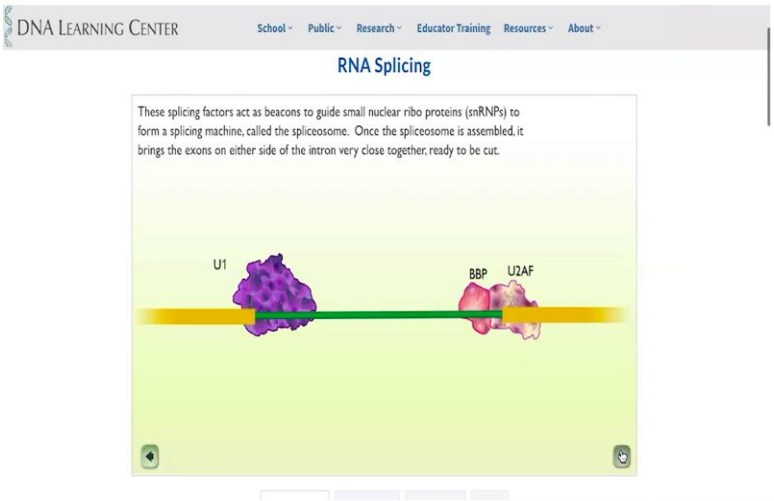

So, small nuclear ribo proteins called snRNPs come together sit in the intron exon junction to form a splicing machine called the spliceosome. Once the spliceosome is assembled, it will bring the exons on either side of the intron very close together and ready to cut and this is shown over here.

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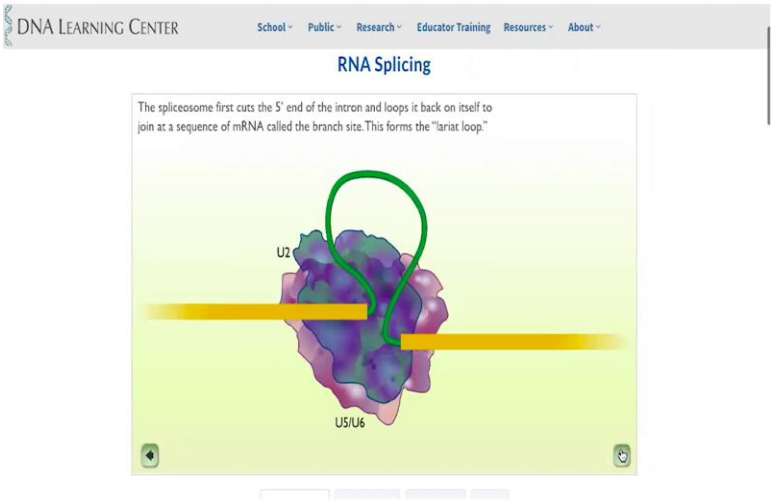

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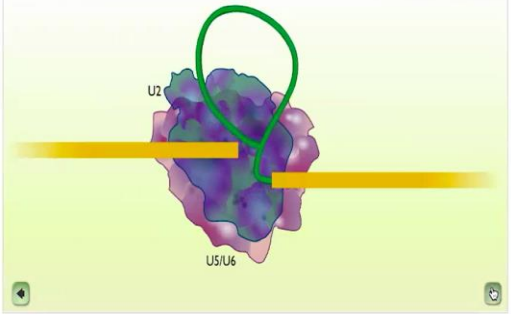
RNA Splicing

Next, the spliceosome cuts the 3' end of the intron, releasing the lariat loop and joining the two exons together.



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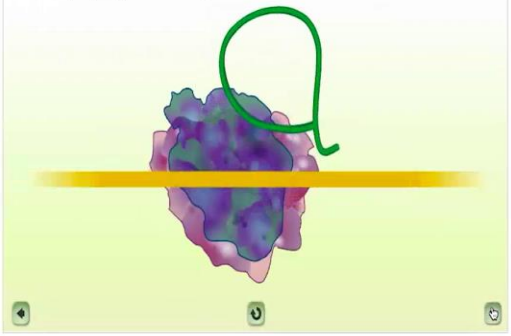

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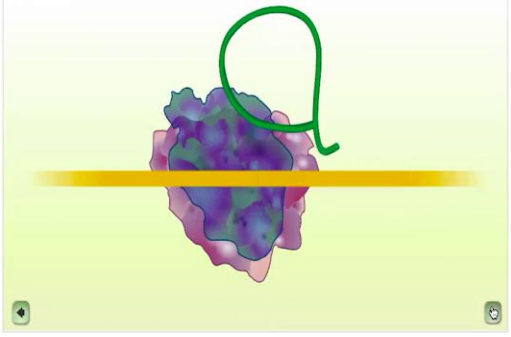
RNA Splicing

After splicing is complete, the edited mRNA and intron are released and the spliceosome disassembles. The lariat loop is also broken down.



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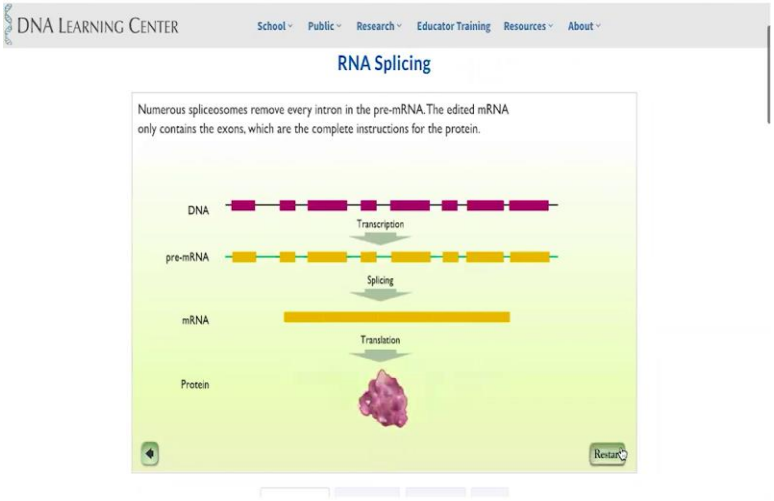
RNA Splicing

Numerous spliceosomes remove every intron in the pre-mRNA. The edited mRNA only contains the exons, which are the complete instructions for the protein.



You can see that the piece of the intron which is a single stranded RNA forms a lariat like structure. Now, you will see that from one end the lariat is cut and joined into a loop. The second end is cut and the two pieces of mRNA the exons are spliced together and the loop is discarded. And this process continues in a systematic way in the pre-mRNA to make the mature RNA. And this mature mRNA which contains less information than the DNA strand it was copied from is finally translated into a protein. So, this is now the process of RNA splicing and I will show this to you in cold spring harbor movie.

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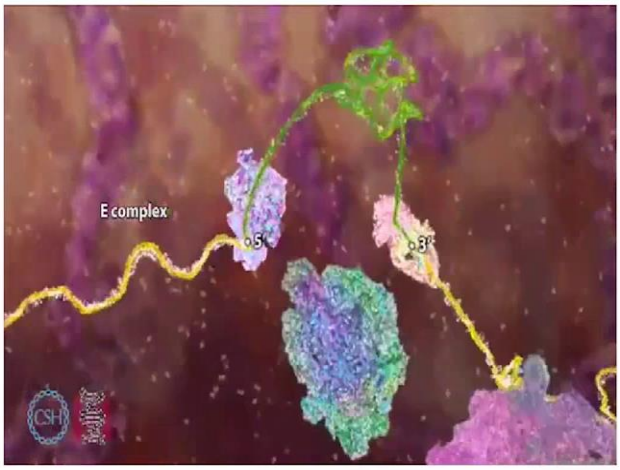
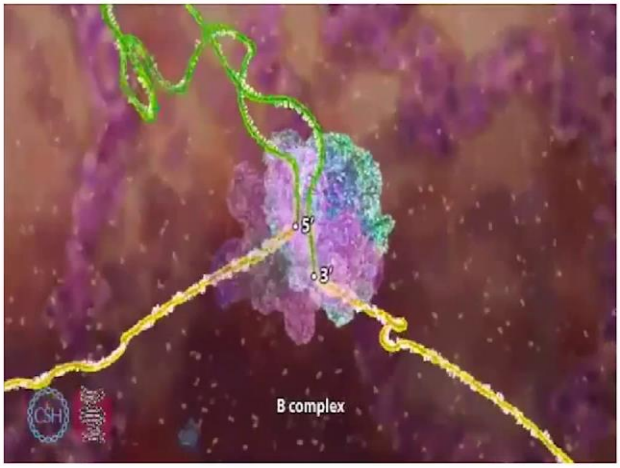
Splicing

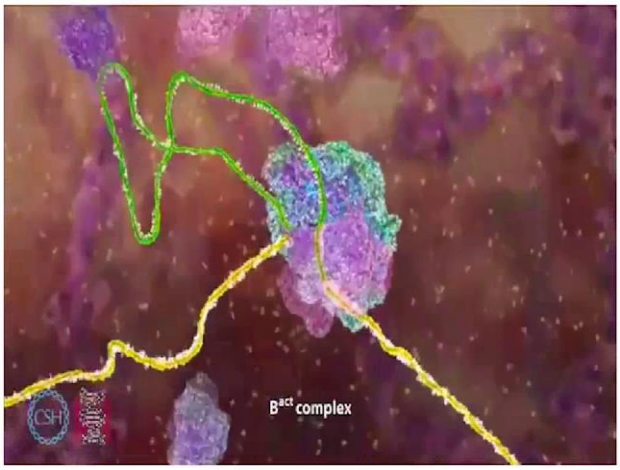
Splicing



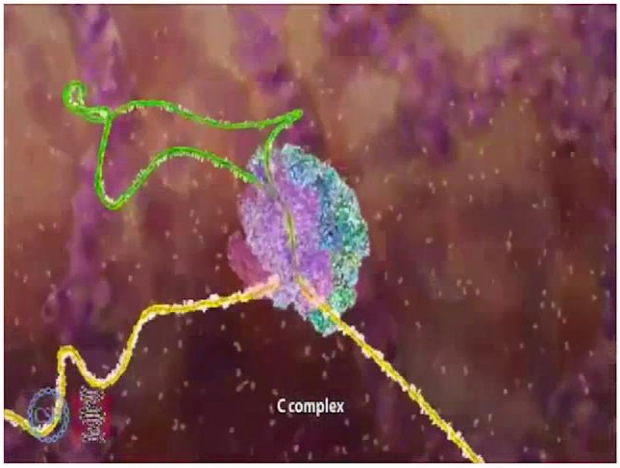
Splicing



Splicing



Splicing



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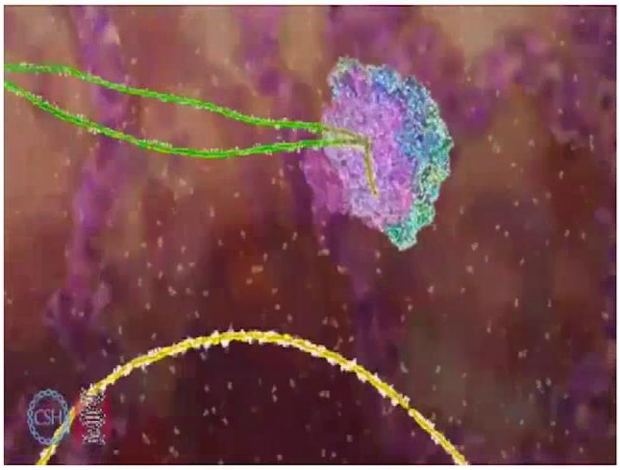

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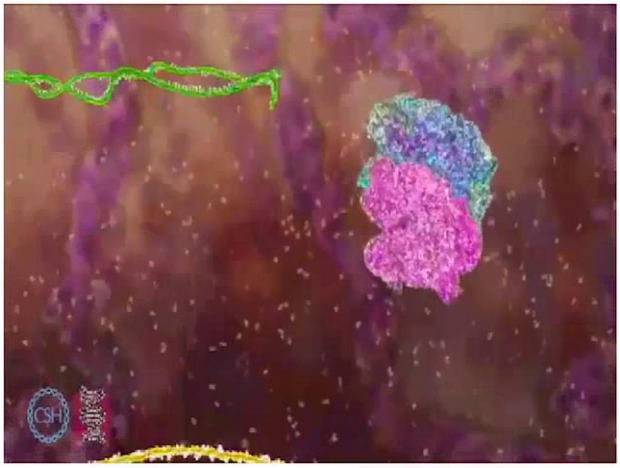
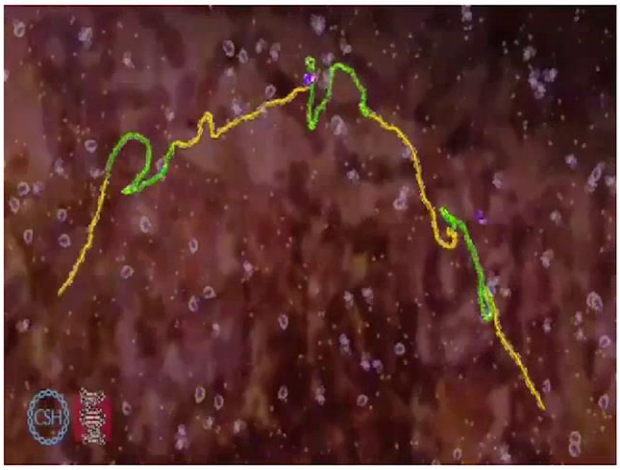
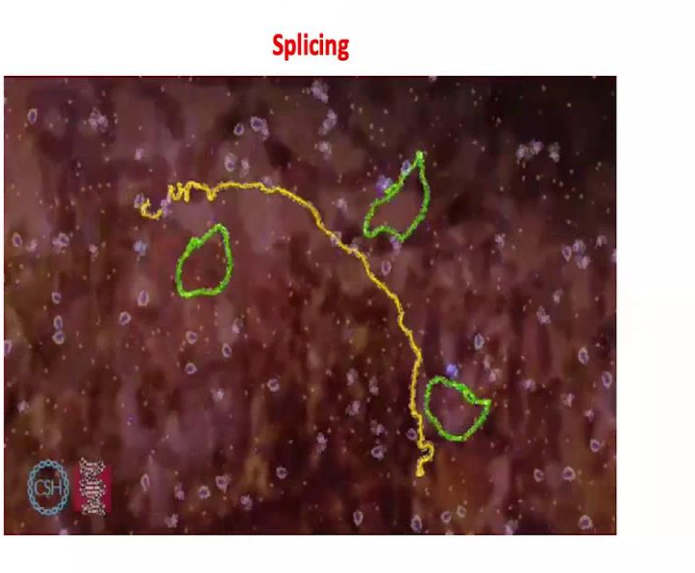


Splicing





As DNA is transcribed into RNA it needs to be edited to remove non-coding regions or introns shown in green. This editing process is called splicing which involves removing the introns leaving only the yellow protein coding regions called exons. RNA splicing begins the assembly of helper proteins at the intron exon borders. These splicing factors act as beacons to guide small nuclear ribo proteins to form a splicing machine called the spliceosome.

The animation is showing this happening in real time. The spliceosome then brings the exons on other side of the intron very close together ready to be cut. One end of the intron is cut and folded back on itself to join and form a loop. The spliceosome then cuts the RNA to release the loop and join the two exons together.

The edited RNA and intron are released and the spliceosome disassembles. This process is repeated for every intron in the RNA. Numerous spliceosomes shown here in purple assemble along the RNA. Each spliceosome removes one intron releasing the loop before disassembling. In this example three introns are removed from the RNA to leave the complete instructions for a protein.