Proteomics
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Slide 5
Gene expression includes all of the cellular activities that lead to the production of a protein, including not only transcription and translation but several types of modifications that can be made at various points along the way. Chromatin can me modified to turn genes on or off. An activated gene is transcribed to produce pre-mRNA. The pre-mRNA undergoes post-transcriptional processing to become the working version of mRNA. The mRNA is then translated to produce the corresponding polypeptide. Post-translational processing modifies the polypeptide to produce the working version of the polypeptide, which is then shipped to its proper destination. Some proteins are constructed of multiple polypeptide subunits. In that case, each different kind of polypeptide is built according to instructions contained in its own gene. Eventually, mRNA and proteins are enzymatically degraded to prevent further production of the proteins and further action by the proteins.

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There are two major ways in which proteins function for regulation:

- In feedback inhibition, the product of a biochemical pathway binds to an enzyme involved in that pathway. The resulting change in shape of the enzyme disables the enzyme, shutting down the step of the pathway that is catalyzed by that enzyme. This shuts down the entire pathway, so the product (which is no longer needed) is no longer produced.
- Proteins can also act as regulatory particles that control the transcription of genes. The regulatory proteins can either turn genes on (cause transcription) or turn genes off (prevent transcription).

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An operon is a set of closely related genes in a prokaryote, sharing a single promoter. Therefore, all of the genes in an operon are transcribed if the promoter is activated. The promoter can be activated (allowing transcription) or repressed (preventing transcription) by the binding of regulatory proteins to the DNA in the promoter region.

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Another example of an operon is shown.

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Not only can the control of transcription in eukaryotes involve multiple different proteins (transcription factors), but sometimes the operation of these transcription factors involves the binding of the factors to nonadjacent regions of DNA. This requires the formation of loops in the DNA molecule to bring the nonadjacent regions into proximity.

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A regulatory protein can function on a moment-to-moment basis, activating a gene only when the protein for which the gene codes is needed by the cell. However, in a multicellular organism having many types of cells, any given cell contains genes coding for proteins that are never needed by that type of cell. Regulatory proteins can function to keep these unneeded genes permanently inactivated.

Slide 11
Post translational modification of a protein often involves attaching groups of atoms onto the protein. This alters the function of the protein (either activating it or inhibiting it), so these modifications act as switches allowing proteins to be turned on or off according to the needs of the cell.

Slide 12
Proteins can operate as signals that change what's happening in a cell. Any signal operates by binding to a receptor molecule, which itself is a protein. Signals can operate over very short distances (cell-to-cell) or over much larger distances. Signals that are released by a cell and have their effects on nearby cells are called autocrine signals (if the target cell is the same type of cell as the cell producing the signal) or paracrine signals (if the target cell is of a different type). Synaptic signals released by neurons and affecting an adjacent cell are called neurotransmitters.

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Signal transduction is the process by which some number of second messengers relay a message from a signal to the cell. The binding of the signal to its receptor is called reception. This causes a change in some sort of molecule (a second messenger), which is now carrying the message. The activation of the second messenger is called transduction. The interaction between the second messenger and the final molecule in the process (the recipient of the message) causes the response. In other words, in signal transduction, the original signal does not directly cause the response; instead, it indirectly causes the response via a second messenger.

Slide 14
A common mechanism by which a signal operates is by phosphorylation of enzymes. An enzyme that phosphorylates another molecule is called a kinase.

Slide 15
The laborious process of protein extraction and purification is summarized.