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 Rao, A., Ryan, K. and Tag, A. Department of Biology, Texas A&M University. “Charging of tRNAs.”  
 Rao, A., Ryan, K. and Fletcher, S. Department of Biology, Texas A&M University. “Ribosome functions.”  
 Rao, A. and Ryan, K. Department of Biology, Texas A&M University. “Translation termination.”  
 Rao, A. and Ryan, K. Department of Biology, Texas A&M University. “Proteins and the ER.”

## CHAPTER 16

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 Rao, A., Ryan, K. Fletcher, S. and Tag, A. Department of Biology, Texas A&M University. “Prokaryotic and eukaryotic expression.”  
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## CHAPTER 17

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 NIH. "Emerging diseases."  
 CDC/James Gathany on Wikimedia Commons. "Bullseye rash."  
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 CDC on Wikimedia Commons. "Lyme disease life cycle."  
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 ARS Image Gallery on Wikimedia Commons. "*E. coli* bacteria."  
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## CHAPTER 23

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## CHAPTER 24

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## CHAPTER 25

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## CHAPTER 26

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## CHAPTER 27

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 Schokraie E, Wamken U, Hotz-Wagenblatt A, Grohne MA, Hengherr S, et al. (2012) on Wikimedia Commons. "*Milnesium tardigradum*."  
 Guidetti, Roberto on Wikimedia Commons. "Tardigrade under microscope."  
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## CHAPTER 30

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## CHAPTER 31

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## CHAPTER 32

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## CHAPTER 33

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 CNX OpenStax on Wikimedia Commons. "Fibrous connective tissue."  
 Echinaceaapallida on Wikimedia Commons. "Hyaline cartilage."  
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 OpenStax. "Types of muscle tissue."  
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 www.scientificanimations.com on Wikimedia Commons. "Brown fat cell."  
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## CHAPTER 34

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 Syahir Hakim on Pixabay. "Koala."  
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## CHAPTER 35

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 CNX OpenStax on Wikimedia Commons. "Open and closed circulatory system."  
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## CHAPTER 37

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## CHAPTER 38

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## CHAPTER 39

Internet Archive Book Images on Wikimedia Commons. “British reptiles and batrachians.”  
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## CHAPTER 40

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## CHAPTER 41

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## CHAPTER 42

Scott Ray on Wikimedia Commons. “High jump.”  
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 OpenStax. “Neuron structure.”  
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 CNX OpenStax on Wikimedia Commons. “Neuron diversity.” Modified.  
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 OpenStax. “Central and peripheral.” Modified.  
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 CNX OpenStax on Wikimedia Commons. “Action potential steps.”  
 CNX OpenStax on Wikimedia Commons. “Action potential.”  
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 Adindva1 on Wikimedia Commons. “Brain-computer interface technology.”  
 CNX OpenStax on Wikimedia Commons. “Calcium initiate LTP or LTD.”  
 www.scientificanimations.com. “Meninges detail.”  
 CNX OpenStax on Wikimedia Commons. “Coronal and saggital sections of the brain.” Modified.  
 Macey et al., 2007 on Wikimedia Commons. “fMRI.”  
 CNX OpenStax on Wikimedia Commons. “Parts of the brain.”  
 CNX OpenStax on Wikimedia Commons. “Motor cortex controls.”  
 CNX OpenStax on Wikimedia Commons. “Brain to body ratio for animals.” Modified.  
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 CNX OpenStax on Wikimedia Commons. “Limbic system.”  
 OpenStax on Wikimedia Commons. “Spinal cord cross section.”  
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 OpenStax. “Autonomic nervous system.” Modified.

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## CHAPTER 43

Anna Shvets on Pexels. "Prosthetic leg."  
 dmkoeh on Pixabay. "Sea star skeleton."  
 Kirkby on Pixabay. "Sally lightfoot crab."  
 Tima Miroshnichenko on Pexels. "Human skeleton."  
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 OpenStax College on Wikimedia Commons. "Types of joints."  
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 OpenStax. "Pivot joint."  
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 www.scientificanimations.com. "Human wrist diagram."  
 Berkshire Community College Bioscience Image Library on Wikimedia Commons. "Skeletal, smooth, and cardiac muscle."  
 CNX OpenStax on Wikimedia Commons. "Skeletal muscle cell."  
 OpenStax on Wikimedia Commons. "Myofibril diagram."  
 OpenStax. "Actin and myosin." Modified.  
 OpenStax. "Muscle contraction."  
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 CNX OpenStax on Wikimedia Commons. "Excitation-contraction coupling."  
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## CHAPTER 44

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## CHAPTER 45

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 OpenStax. "IUCN Redlist."  
 Our World In Data on Wikimedia Commons. "Red List Index."  
 Sven Lachmann on Pixabay. "Bald eagle."  
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 WikiImages on Pixabay. "Wolf pack."  
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