Molecular Biology of the Cell, 6th Edition

Chapter 1: Cells and Genomes

(The Diversity of Genomes and the Tree of Life)
Length: 00:56:15
Corals and Coral Reefs: Nancy Knowlton
Knowlton talks about the phenomenal biodiversity found in coral communities and why this diversity is important to reef health. She explains how difficult it is to classify corals and the many organisms with which they co-exist.

Chapter 2: Cell Chemistry and Bioenergetics

(How Cells Obtain Energy from Food)
Length: 00:30:15
Plant Development: Elliot Meyerowitz
Meyerowitz and his lab use live imaging techniques to study the positioning and growth of leaves and flowers. Remarkably, cells have the ability to sense mechanical forces produced by surrounding cells and respond accordingly by redistributing structural and growth proteins.

Chapter 3: Proteins

(The Shape and Structure of Proteins)
Length: 00:21:05
Protein Folding, Prions, and Disease: Susan Lindquist
Dr. Lindquist explains the problem of protein folding. Proteins leave the ribosome as long, linear chains of amino acids but they need to fold into complex three dimensional shapes in the extremely crowded environment of the cytoplasm

(The Shape and Structure of Proteins)
Length: 00:20:27
Neurodegenerative disease: The Coming Epidemic: Gregory Petsko
The brains of patients with Alzheimer's, Parkinson's, and ALS/Lou Gehrig's diseases are characterized by the presence of protein aggregates due to protein misfolding. Petsko describes mechanisms that provide insight into potential treatments.

(The Shape and Structure of Proteins)
Length: 00:21:22
Protein Design: David Baker
Using computer programming, Baker and colleague are able to design an amino acid sequence that will fold into a predicted protein structure. This technique has potentially practical uses in the treatment of infection.

(The Shape and Structure of Proteins)
Length: 00:27:05
The Evolutionary Design of Proteins: Rama Ranganathan
In this talk, Ranganathan discusses the way that proteins spontaneously fold into complex 3 dimensional structures in order to fulfill their biochemical functions.

(Protein Function)
Length: 00:42:02
GTP-Binding Proteins as Molecular Switches: Alfred Wittinghofer
When a growth factor binds to the plasma membrane of a quiescent cell, an intracellular signaling pathway is activated telling the cell to begin growing. Wittinghofer discusses the mechanisms of this growth-signaling pathway.

(Protein Function)
Length: 00:23:07
Protein Phosphorylation in Biology: Susan Taylor
Protein phosphorylation is a reaction in which a phosphate group is covalently coupled to another molecule. Taylor discusses the importance of phosphorylation as a mechanism for protein regulation.

(Protein Function)
Length: 00:28:15
Architecture of a Protein Kinase: Susan Taylor
Protein kinases are enzymes that transfer the terminal phosphate group of ATP to one or more specific amino acids of a target protein. By studying protein kinase architecture, Taylor's lab has gained a general understanding of this protein in the process of phosphorylation.

Chapter 4: DNA, Chromosomes, and Genomes

(The Structure and Function of DNA)
Length: 00:39:34
Nanofabrication via Structural DNA: William Shih
Shih describes how DNA can be used as a building material to construct nanoscale objects and how these nanostructures can be used for practical purposes.

(How Genomes Evolve)
Length: 00:54:51
Genetic Variation and Phylogeography: Scott Edwards
A phylogenetic tree constructed from a comparison of genes shows the relationship between different groups of organisms. Edwards explains how these gene trees can be used to link genetic variation to geographic distribution of populations.

(How Genomes Evolve)
Length: 00:38:13
The Dynamic Genome: Susan Wessler
Transposable elements (TEs) are small movable pieces of DNA that can insert throughout the genome. Wessler discusses work from her lab analyzing the impact of TEs on gene and genome evolution.

(How Genomes Evolve)
Length: 00:52:11
Fruits of the Genome Sequence: David Botstein
Sequencing the genomes of multiple organisms has shown that many genes (and likely many biological processes) have been conserved during evolution. David Botstein studies the evolutionary forces that regulate and maintain the coordination of growth rate, stress response, metabolism and cell division in yeast.

(How Genomes Evolve)
Length: 00:36:20
African Genomics: Human Evolution and Migration: Sarah Tishkoff
Tishkoff provides an overview of the evolution of modern humans and their migration out of Africa. Her lab studies genetic variation at the genome level in populations throughout the world, with an emphasis on Africa.

(How Genomes Evolve)
Length: 00:38:57
Cone Snail Venom Peptides: Toto Olivera
Cone snails are a source of over 100,000 diverse neurotoxins. Olivera discusses how mutations in the variable regions have allowed the peptides to rapidly evolve to target different ion channels. He explains how his lab uses a specific class of snail venom peptides to study the diversity of potassium channel subtypes present in neurons.

(How Genomes Evolve)
Length: 00:32:51
Molecular Arms Races Between Primate and Viral Genomes: Harmit Malik
In the battle for evolutionary supremacy, the host and the virus must be constantly undergoing adaptive changes in order to survive. This is the premise for Malik's talk, which focuses on specific evolutionary adaptations of both parties.

Chapter 5: DNA Replication, Repair, and Recombination

(Transposition and Conservative Site-Specific Recombination)
Length: 00:38:13
The Dynamic Genome: Susan Wessler
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Chapter 6: How Cells Read the Genome: From DNA to Protein

Length: 00:38:29
Single Molecule Manipulation in Biochemistry: Carlos Bustamante
Many cellular processes are carried out by a small number of molecules. Bustamante and colleagues use optical tweezers to manipulate single molecules and gain insight on mechanisms of DNA transcription and RNA translation.

(From DNA to RNA)
Length: 00:35:58
RNA Processing: Melissa Moore
Splicing is the process in which non-protein coding sequences are excised from RNA sequences. Dr. Moore explains why excising these introns serves an important evolutionary purpose.

(From DNA to RNA)
Length: 00:31:29
The Molecular Biology of Gene Regulation: Robert Tjian
The conversion of DNA to RNA relies on transcription factors (TFs) to recognize the coding sequences and to transcribe the correct genes. Tjian explains how TFs play a massive role in regulating the unique genetic identity of different cell types.

(From DNA to RNA)
Length: 00:09:49
Transcriptional Precision in the Drosophila Embryo: Michael Levine
Enhancers are elements located up or downstream from the transcription start site of a gene. Levine discusses the importance of enhancers in regulating gene expression patterns.

(From DNA to RNA)
Length: 00:23:04
RNA structure, catalytic function and recognition by protein enzymes: Anna Marie Pyle
RNA molecules are diverse in structure and function. In this talk, Pyle explains how the structure of RNA can provide information about its function.

(From RNA to Protein)
Length: 00:38:10
Chaperone-Assisted Protein Folding: Arthur Horwich
Chaperonins allow for proper assembly and folding of other proteins. In this series of talks, Horwich discusses the importance of protein folding and how chaperones, specifically chaperonins, mediate proper folding.

(From RNA to Protein)
Length: 00:43:06

Protein Synthesis: Rachel Green
Translation is the process by which nucleotides, the “language” of DNA and RNA, are translated into amino acids. The Green lab uses biochemical and genetic techniques to investigate how ribosomes detect defective mRNAs and trigger events leading to their degradation.

(The RNA World and the Origins of Life)
Length: 00:54:41
The Origin of Life on Earth: Jack Szostak
What is the probability that, somewhere in our galaxy, there is another planet that could sustain life? By studying the chemistry of early planets and a primitive self-replicating protocell, Szostak makes predictions about the existence of life on other planets.

Chapter 7: Control of Gene Expression

(An Overview of Gene Control & Post-Transcriptional Controls)
Length: 00:53:58
The Life of Eukaryotic mRNA: Roy Parker
Parker describes the mechanisms that control mRNA localization, translation and degradation. These mechanisms allow for the proper regulation of the amount, duration, and location of protein production.

(Mechanisms that Reinforce Cell Memory in Plants and Animals)
Length: 00:25:27
How Do Plants Know When to Flower?: Richard Amasino
Amasino describes two key genes involved in the regulation of plant flowering, and how the expression of these genes is influenced by environmental cues, such as day length and temperature, and modification of chromatin.

(Regulation of Gene Expression by Noncoding RNAs)
Length: 00:42:44
microRNAs: David Bartel
microRNAs are short hairpin structures that bind to target mRNA sequences and repress their function. Bartel discusses how microRNA regulate gene expression.

Chapter 8: Analyzing Cells, Molecules, and Systems

(Analyzing Proteins)
Length: 00:42:09
Snapshots of Metalloproteins: Catherine Drennan
Drennan describes a metalloprotein as an amalgam of metal and a protein. This configuration can make for an array of amazingly reactive proteins that contribute to various essential biological mechanisms (e.g. photosynthesis).

(Analyzing and Manipulating DNA)
Length: 00:26:12
Synthetic Biology and Metabolic Engineering: Kristala L. J. Prather
Synthetic biology involves applying engineering to principles to biological systems to build “biological machines” that can produce small molecules of choice. Prather
discusses how synthetic DNA can be added to biological hosts in order to produce small molecules of choice.

(Studying Gene Expression and Function)
Length: 00:37:56
Genes, the Brain, and Behavior: Cori Bargmann
Bargmann explains how the mutation of a single gene can drastically change the behavioral response in organisms as diverse as nematodes, dogs, and humans.

(Studying Gene Expression and Function)
Length: 00:25:05
Tomorrow's Table: Organic Farming, Genetics and the Future of Food: Pamela Ronald
One way to study the function of different genes is to see what happens in the organism when that gene is missing. Ronald describes how creating genetic mutations can disrupt an organism's response to disease and environmental stress.

(Studying Gene Expression and Function)
Length: 00:12:47
The Genetic Basis of Evolutionary Change in Morphology and Behavior: Hopi Hoekstra
How do genetic changes result in adaptations that increase the survival and reproduction of organisms? Hoekstra discusses two genetic adaptations, coat color and burrowing, that have influenced the survival of mouse populations.

(Studying Gene Expression and Function)
Length: 00:24:50
Plant Nutrition and Sustainable Agriculture: Luis Herrera-Estrella
Herrerra-Estrella tackles the issue of optimizing food production while minimizing the environmental impact of agriculture using genetic techniques.

Chapter 9: Visualizing Cells

(Looking at Cells in the Light Microscope)
Length: 00:50:01
Fluorescence Imaging at Nanoscale: Xiaowei Zhuang
Traditional light microscopy cannot resolve molecules that are closer than the 200 nm diffraction limit. Zhuang explains how Stochastic Optical Reconstruction Microscopy (STORM) overcomes this limit.

(Looking at Cells in a Light Microscope)
Length: 00:28:02
Rapid Adaptive Camouflage and Signaling in Cephalopods: Roger Hanlon
While camouflage is poorly understood, it is a key evolutionary mechanism in predation and defense. Hanlon shows us results from his lab suggesting that visual signaling controls the adaptive coloration of cephalopods. He also uses light microscopy to visualize the distribution of opsin, a visual signaling molecule.

(Looking at Cells in the Light Microscope)
Length: 00:28:31
Developing Single Molecule Technologies to Study Nanomachines: Taekjip Ha
Recent improvements in single molecule technologies have enhanced our understanding of nanomachines; the cells' tiny engines. Ha explains how scientists have used fluorescence microscopy, in combination with other tools, to study nanomachines.

Chapter 10: Membrane Structure

(The Lipid Bilayer)
Length: 00:28:29
Lipids as Organizers in Cell Membranes: Kai Simons
In the history of biochemistry, a majority of the focus has been placed on the proteins that make up living organisms. Simmons explains how lipids play an important role in the organization of cellular trafficking.

Chapter 11: Membrane Transport of Small Molecules and Electrical Properties of Membranes

(Channels and the Electrical Properties of Membranes)
Length: 00:26:51
Electrical Signaling: Life in the Fast Lane: William Catterall

How does a baseball player react quickly enough to hit a 90 mph fastball or a tennis player to hit a 60 mph serve? Electrical signals allow for messages to be transmitted quickly and efficiently through the nervous system. Catterall describes the ions and channels that play an important role in neurotransmission.

(Channels and the Electrical Properties of Membranes)
Length: Length: 00:38:57
Cone Snail Venom Peptides: Toto Olivera
Cone snails are a source of over 100,000 diverse neurotoxins. Olivera discusses how mutations in the variable regions have allowed the peptides to rapidly evolve to target different ion channels. He explains how his lab uses a specific class of snail venom peptides to study the diversity of potassium channel subtypes present in neurons.

Chapter 12: Intracellular Compartments and Protein Sorting

(The Transport of Proteins into Mitochondria and Chloroplasts)
Length: 00:30:50
Getting Fuel to the Cell's Engine: The Importance of Metabolism in Disease: John Schell
John Schell tells the story of a little girl that died from an unknown metabolic disease. Decades later Schell and colleagues reveal a mutation in her MPC gene. The MPC is responsible for proper transport of pyruvate (a nutrient) to the mitochondria, where it can be broken down to release energy.

Chapter 13: Intracellular Membrane Traffic

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Lipids as Organizers in Cell Membranes: Kai Simons
In the history of biochemistry, a majority of the focus has been placed on the proteins that make up living organisms. Simmons explains how lipids play an important role in the organization of cellular trafficking.

(Transfer from the Trans Golgi Network to the Cell Exterior: Exocytosis)
Length: 00:36:35
Studying Protein Secretion in Yeast: Randy Schekman
Protein secretion is the discharge of soluble molecules to the cell's exterior. Secretion is executed by vesicles, which carry the molecules to be secreted. The vesicles fuse and integrate with the cell membrane to release their contents.

(Transfer from the Trans Golgi Network to the Cell Exterior: Exocytosis)
Length: 00:25:15
Biochemical Reconstitution of Transport Vesicle Budding: Randy Schekman
Schekman demonstrates how the process of vesicle budding can be reconstituted through isolation and purification of secretory proteins. This method has provided useful information about the functional role of SEC proteins in budding.

Chapter 14: Energy Conversion: Mitochondria and Chloroplasts

(The Mitochondrion)
Length: 00:30:50
Getting Fuel to the Cell's Engine: The Importance of Metabolism in Disease: John Schell
John Schell tells the story of a little girl that died from an unknown metabolic disease. Decades later Schell and colleagues reveal a mutation in her MPC gene. The MPC is responsible for proper transport of pyruvate (a nutrient) to the mitochondria, where it can be broken down to release energy.

Chapter 15: Cell Signaling

(Principles of Cell Signaling)
Length: 00:31:34
Marvels of Bacterial Behavior: Howard Berg

How does E. Coli swim up or down a chemical gradient? In this talk Howard Berg discusses how the rotation of bacterial flagellum is by receptors that detect a chemical gradient and transfer this information, via protein phosphorylation, to the motor.

(Signaling through G-Protein-Coupled Receptors)
Length: 00:28:02
Rapid Adaptive Camouflage and Signaling in Cephalopods: Roger Hanlon
While camouflage is poorly understood, it is a key evolutionary mechanism in predation and defense. Hanlon shows us results from his lab suggesting that visual signaling controls the adaptive coloration of cephalopods. He also uses light microscopy to visualize the distribution of opsin, a visual signaling molecule.

(Signaling Through Enzyme-Coupled Receptors)
Length: 00:42:02
GTP-Binding Proteins as Molecular Switches: Alfred Wittinghofer
Wittinghofer explains the link between GTPases and disease. Ras, a GTPase, is a key molecule in the intracellular signaling that activates cell growth. Mutations in the Ras gene can cause unregulated activation of Ras and tumor formation.

(Alternative Signaling Routes in Gene Regulation)
Length: 00:33:17
Circadian Clocks: Joseph Takahashi
A circadian clock is an internal cycling process that produces a particular change in a cell or organisms with a period of around 24 hours. Takahashi describes the identification circadian genes and associated mechanisms.

(Alternative Signaling Routes in Gene Regulation)
Length: 00:28:09
Neurobiology of Monarch Butterfly Migration: Steven M. Reppert
Each fall, several hundred million Monarchs fly from the eastern United States and southern Canada to central Mexico. This impeccable sense of direction can be attributed to intrinsic circadian clocks.

(Signaling in Plants)
Length: 00:30:15
Plant Development: Elliot Meyerowitz
Meyerowitz and his lab use live imaging techniques to study the positioning and growth of leaves and flowers. Remarkably, cells have the ability to sense mechanical forces produced by surrounding cells and respond accordingly by redistributing structural and growth proteins.

Chapter 16: The Cytoskeleton

(Function and Origin of the Cytoskeleton)
Length: 00:27:15
The Spatial Organization of Bacterial Cells: Christine Jacobs-Wagner
Since they have no membrane-bound internal organelles, bacteria exhibit unique spatial organization compared to eukaryotes. Jacobs-Wagner explains how bacterial cells can harness the elastic dynamics of DNA to effectively separate two chromosomes during cell division.

(Actin and Actin-Binding Proteins)
Length: 00:43:49
Cell Motility and the Cytoskeleton: Julie Theriot
The intracellular bacterial pathogen *Listeria monocytogenes* uses actin polymerization to assemble filaments that propel the bacteria through the cytoplasm of infected cells. Theriot describes the role of cytoskeletal molecules in bacterial cell motility.

(Microtubules)
Length: 00:26:01

Self-organization in Biology: Tim Mitchison
Mitchison describes how microtubules self organize and influence the spatial organization of cells. He also describes how microtubules arrange themselves in spindle formation.

(Microtubules)
Length: 00:43:16
Molecular Motor Proteins: Ron Vale
Molecular motor proteins are fascinating enzymes that power much of the movement performed by living organisms. Vale discusses how dynein and kinesin, two motor proteins, use the energy from ATP hydrolysis to move along microtubules.

(Microtubules)
Length: 00:25:19
The Mechanisms of Dynein Motility: Ron Vale
In this talk, Vale discusses work on the mechanism of movement by dynein, a motor protein that is not yet well understood.

(Microtubules)
Length: 00:27:58
Organization of the Cytoplasm: Anthony Hyman
A eukaryotic cell is often 5-6 orders of magnitude larger than the molecules that make it up. How is it that these molecules interact to organize the complex structures that constitute a cell?

(Intermediate Filaments and Septins)
Length: 00:36:08
Intermediate Filaments: Robert Goldman
Dr. Goldman introduces us to cytoskeletal intermediate filaments (IF) beginning with an overview of IF formation and properties.

(Cell Polarization and Migration)
Length: 00:34:57
Knowing Where to Go: How Cells Drive Without Eyes: Jayme Dyer
Sperm, for example, can swim to an egg during fertilization. Dyer explains how cells use chemical gradients to “drive” towards other cells.

Chapter 17 The Cell Cycle

Length: 00:29:34
Separating Duplicated Chromosomes: Richard McIntosh
Both the length and amount of DNA are presented as problems for chromosome segregation, particularly in eukaryotic cells. The actions of cohesins and of chromosome condensation are described as solutions

(The Cell-Cycle Control System)
Length: 00:28:31
Controlling the Cell Cycle: Introduction: David Morgan
Morgan provides a general overview of the cell-cycle control system, a complex regulatory network that guides the cell through the steps of cell division

(The Cell-Cycle Control System)
Length: 00:30:08
Controlling the Cell Cycle: CDK Substrates: David Morgan
Cyclin-dependent kinases (Cdks) are the central components of the control system that initiates the events of the cell cycle. Morgan discusses how the Cdks trigger cell-cycle events.

(Mitosis)
Length: 00:39:02

Understanding Mitosis through Experimentation: Richard McIntosh
This lecture describes some key experiments showing the dynamics of a formed mitotic spindle and the ways these may contribute to accurate chromosome motion.

(Mitosis)
Length: 00:41:27
Moving Chromosomes Through Spindle Poles: Richard McIntosh
Evidence shows how microtubule depolymerization can move chromosomes in vitro. McIntosh explores the nature of some of the protein complexes that can couple chromosomes to microtubules and take advantage of this reaction.

(Mitosis & Meiosis)
Length: 00:26:01
Self-organization in Biology: Tim Mitchison
Mitchison describes how microtubules self organize and influence the spatial organization of cells. He also describes how microtubules arrange themselves in spindle formation.

(Cytokinesis)
Length: 00:30:05
Cell Motility and Cytokinesis: Thomas Pollard
Cytokinesis is an actin-myosin-dependent process by which a contractile ring forms around the middle of a cell and squeezes to divide it into two daughter cells. Pollard and colleagues use structural, biochemical, and cellular strategies to understand the complex mechanisms involved in the formation and regulation of the contractile ring.

(Meiosis)
Length: 00:19:19
Chromosome Dynamics During Meiosis: Abby Dernburg
Meiosis is the process of cell division that gives rise to germ cells such as eggs, sperm, pollen, and spores. Dernburg asks the question of how homologous pairs of chromosomes find each other and how they undergo pairing and synapsis.

(Control of Cell Division and Cell Growth)
Length: 00:27:15
Yeast Sex: Andrew Murray
People are complicated, yeast are simple. This is the reason why Murray studies yeast sex. The simplicity of this organism has allowed scientists to acquire a significant amount of information on basic mechanisms of cell division.

(Control of Cell Division and Cell Growth)
Length: 00:32:44
Consequences of Aneuploidy: Angelika Amon
Aneuploidy is the presence of an abnormal number of chromosomes in a cell. By genetically and biochemically characterizing aneuploid cells, Amon and colleagues may gain insights into the role of aneuploidy in cancer.

(Control of Cell Division and Cell Growth)
Length: 00:52:11
Fruits of the Genome Sequence: David Botstein
Sequencing the genomes of multiple organisms has shown that many genes (and likely many biological processes) have been conserved during evolution. David Botstein studies the evolutionary forces that regulate and maintain the coordination of growth rate, stress response, metabolism and cell division in yeast.

Chapter 18: Cell Death

Length: 00:23:40
How Can We Sense Infection? Helping to Treat Sepsis: Jianjin Shi

Shi studies the mechanisms that lead to sepsis, a life-threatening condition caused by the immune system's overreaction to bacterial infection. Shi and colleague reveal that caspases, proteins that mediate apoptosis, can recognize the toxic substance that triggers sepsis.

Chapter 19: Cell Junctions and the Extracellular Matrix

(Cell-Cell Junctions)
Length: 00:25:06
Epithelial Homeostasis: Jody Rosenblatt
Both our entire body and all of our organs are covered with a protective layer of epithelial cells. These cells are constantly replicating and dying and a balance between cell death and division is critical to maintain epithelial homeostasis.

(Cell-Cell Junctions)
Length: 00:26:53
Choanoflagellates and the Origin of Animal Multicellularity: Nicole King
S. Rosetta is a good model for studying the evolution of multicellular life because they can exists as unicellular or multicellular organisms. The King lab has found that multicellularity in S. Rosetta can be regulated by the surrounding bacteria they eat.

(The Extracellular Matrix of Animals)
Length: 00:49:47
Extracellular Matrix and Tissue Specificity: Mina Bissell
How can trillions of cells all with the same genetic information coordinate to form a complex organism? To address this question, Bissell uses the mammary gland as an experimental "organism".

Chapter 20: Cancer

(Cancer-Critical Genes: How They Are Found and What They Do)
Length: 0:33:35
Circulating tumor cell clusters: the 'bad actors' of cancer metastasis: Mohit Kumar Jolly
Despite major advances in cancer biology, we do not fully understand the molecular cues that trigger metastasis. Jolly and colleagues developed a model combining theoretical physics and experimental biology to identify cancer cells with specific properties.

(Cancer Critical Genes: How They are Found and What They Do)
Length: 00:28:37
Cancer: The Rise of the Genetic Paradigm: J. Michael Bishop
Bishop explains the Genetic Paradigm of Cancer, a unifying principle, stating that all cancer arises from the malfunction of genes. This principle lies at the forefront of recent cancer research that uses sequencing of various cancer genomes to better understand the complexity and heterogeneity of different cancers.

(Cancer Critical Genes: How They are Found and What They Do)
Length: 00:44:46
Brain Tumors and Stem Cells: Alfredo Quiñones-Hinojosa
Quiñones-Hinojosa discusses the history of brain tumors, different types of tumors and what this means for treatment and prognosis. Furthermore, he describes how brain tumor stem cells can provide important insights into the cause and treatment of cancer.

(Cancer Critical Genes: How They are Found and What They Do)
Length: 00:30:21
Solving a Family Mystery: Hunting for the Genes Behind Skin Cancer: C. Daniela Robles Espinoza
Melanoma is a deadly skin cancer that is very rare in the human population. Robles-Espinoza and colleagues identified a rare mutation in the POT1 gene that can be linked to familial cases of melanoma.

(Cancer-Critical Genes: How They are Found and What They Do)

Length: 00:55:02
GTPase Reactions and Disease: Alfred Wittinghofer
Wittinghofer explains the link between GTPases and disease. Ras, a GTPase, is a key molecule in the intracellular signaling that activates cell growth. Mutations in the Ras gene can cause unregulated activation of Ras and tumor formation.

Chapter 21: Development of Multicellular Organisms

(Overview of Development)
Length: 00:34:44
Plant development and its implications for human and global health: Dominique Bergmann
Bergmann illustrates how plant biology can provide insights into stem cell regeneration, mechanisms of cell fate determination, and global climate change.

(Mechanisms of Pattern Formation)
Length: 00:26:05
The Evolution of Limbs from Fins: Neil Shubin
In order to learn how human limbs evolved from fish fins, Shubin searched for a fossil intermediate between fish and tetrapods. He and his lab identified a flat-headed fish with fin bones corresponding to limb and wrist bones, and used developmental genetics to investigate the evolution of limb development.

(Mechanisms of Pattern Formation)
Length: 00:34:38
Signaling at a distance: communicating by touch: Thomas Kornberg
Cytonemes are specialized signaling filopodia that can transport secreted molecules, inducers, from producer to recipient cells. Using fluorescent microscopy in *Drosophila*, Kornberg shows how these inducers are transported via cytonemes from the wing disc to the air sac primordium.

(Developmental Timing)
Length: 00:25:27
How Do Plants Know When to Flower?: Richard Amasino
Amasino describes two key genes involved in the regulation of plant flowering, and how the expression of these genes is influenced by environmental cues, such as day length and temperature, and modification of chromatin.

(Neural Development)
Length: 00:26:18
Brain Pathways for Vocal Learning: Erich Jarvis
Vocal learning is the ability to hear a sound and repeat it. Jarvis proposes how vocal learning may have evolved. He explains that the brain areas that control vocal learning may have evolved from a duplication of a pre-existing neural circuit that controls motor movement.

Chapter 22: Stem Cells and Tissue Renewal

(Regeneration and Repair)
Length: 00:30:36
Regeneration in Planarians: Alejandro Sánchez Alvarado
Planarians are free-living flatworms best known for their amazing ability to regenerate. Dr. Sánchez Alvarado discusses how understanding the mechanisms of planarian regeneration can provide insights into previously unknown biological processes in humans.

(Regeneration and Repair)
Length: 00:34:44
Plant development and its implications for human and global health: Dominique Bergmann
Bergmann illustrates how plant biology can provide insights into stem cell regeneration, mechanisms of cell fate determination, and global climate change.

(Cell Reprogramming and Pluripotent Stem Cells)
Length: 00:39:03
Tissue Engineering: Sangeeta Bhatia
The Bhatia lab has successfully engineered microscale human livers that can be used as a model to understand how the liver responds to drugs, viruses, and parasites. Bhatia discusses the challenges of engineering a functional tissue that reproduces the micro-architecture of tissue in vivo.

(Cell Reprogramming and Pluripotent Stem Cells)
Length: 00:37:45
Controlled Drug Release Technology: Robert S. Langer
Langer describes the drug release technologies and biomaterials that have led to a significant improvement in drug efficacy. Some of these technologies have even been adapted to other medical uses, including the use of synthetic polymers to act as scaffolds onto which a patient's cells can be seeded to grow a new structure.

Chapter 23: Pathogens and Infection

(Introduction to Pathogens and the Human Microbiota)
Length: 0:29:12
Pseudomonas aeruginosa survives with a gut reaction: Michele LeRoux
When we think about bacteria, we usually don't think about the fact that their fiercest enemies may be other bacteria competing for resources. LeRoux explains that when bacteria establish and maintain communities, their interactions with one another can turn deadly.

(Introduction to Pathogens and the Human Microbiota)
Length: 00:53:44
Microbial Diversity and Evolution: Dianne Newman
Microbes are ancient, numerous, ubiquitous, and diverse. Newman explains how these four characteristics have allowed microbes to grow, divide, and profoundly impact their environment.

(Introduction to Pathogens and the Human Microbiota)
Length: 00:23:11
Bacteriophages: Genes and Genomes: Graham Hatfull
Bacteriophage, viruses that specifically infect bacteria, provide a large, unexplored reservoir of genetic information. Hatfull discusses how exploring this genetic reservoir may lead to important insights about human disease.

(Introduction to Pathogens and the Human Microbiota)
Length: 00:27:15
The Spatial Organization of Bacterial Cells: Christine Jacobs-Wagner
Since they have no membrane-bound internal organelles, bacteria exhibit unique spatial organization compared to eukaryotes. Jacobs-Wagner explains how bacterial cells can harness the elastic dynamics of DNA to effectively separate two chromosomes during cell division.

(Cell Biology of Infection)
Length: 00:49:52
Virus Structures: Stephen C. Harrison
Enveloped viruses infect cells by inducing the fusion of the viral and host cell membranes. Harrison describes how understanding the structure of viruses can provide insight into the mechanisms of infection.

(Cell Biology of Infection)
Length: 00:34:16
Assembly-line Biosynthesis of Polyketide Antibiotics: Chaitan Khosla
Polyketide antibiotics include many of the most commonly used antibiotics in medicine today such as erythromycin, rapamycin and avermectin. By understanding the enzymes that make these antibiotics naturally in bacteria, Khosla suggests the possibility of discovering new antibiotics.

(Cell Biology of Infection)
Length: 00:23:42
The Bacterial Pathogen Listeria Monocytogenes: Pascale Cossart
Listeria monocytogenes, a food-born, intracellular pathogen, is a true cell biologist, manipulating all aspects of cell function. In this talk, Cossart discusses the many strategies this pathogen uses to grow and proliferate.

(Cell Biology of Infection)
Length: 00:44:12
Pathogenic Bacteria: Ralph Isberg
Isberg describes the mechanisms that pathogens use to cause damage to the host and how communities of pathogenic bacteria can express different protein profiles depending on their microenvironment.

(Cell Biology of Infection)
Length: 00:28:54
Cell Motility and the Cytoskeleton: Julie Theriot
The intracellular bacterial pathogen *Listeria monocytogenes* uses actin polymerization to assemble filaments that propel the bacteria through the cytoplasm of infected cells. Theriot describes the role of cytoskeletal molecules in bacterial cell motility.

(Cell Biology of Infection)
Length: 0:38:12
H. pylori finds its home: Julie Huang
Most microorganisms cannot survive in the hostile acidic environment of the stomach, but somehow *Helicobacter pylori* call the stomach its home. Infection with *H. pylori* can cause stomach ulcers in humans and is a risk factor for the development of stomach cancer

Chapter 24: The Innate and Adaptive Immune System

(The Innate Immune System)
Length: 00:23:40
How Can We Sense Infection? Helping to Treat Sepsis: Jianjin Shi
Shi studies the mechanisms that lead to sepsis, a life-threatening condition caused by the immune system's overreaction to bacterial infection. Shi and colleague reveal that caspases, proteins that mediate apoptosis, can recognize the toxic substance that triggers sepsis.

(Overview of the Adaptive Immune System)
Length: 00:36:58
The Immunological Synapse: Michael Dustin
Adaptive immunity allows an individual to specifically recognize and respond to a vast number of molecules. In this talk, Dustin describes the mechanisms of antigen recognition and some of the key molecular players.

(B Cells and Immunoglobulins)
Length: 00:15:56
Allergies and the Immune System: Avery August
August gives an overview of how cells of the immune system interact to generate an allergic response, and then describes research into the molecular basis of mast cell degranulation.