

## Featured Content

(<http://www.nature.com/scitable/topics>)

## Essentials of Genetics

(<http://www.nature.com/scitable/course-cover/Essentials-of-Genetics-8>)

### Unit 1: What Is DNA? What Does DNA Do?

What smaller elements make up the complex DNA molecule, how are these elements arranged, and how is information extracted from them? This unit answers each of these questions, and it also provides a basic overview of how DNA was discovered.

- Introduction: What Is DNA?
- DNA Is a Structure That Encodes Biological Information
- Discovery of the Function of DNA Resulted from the Work of Multiple Scientists
- Cells Can Replicate Their DNA Precisely
- The Information in DNA Is Decoded by Transcription
- The Information in DNA Determines Cellular Function via Translation

### Unit 2: How Does DNA Move from Cell to Cell?

The passage of DNA from one cell to another is the basic means by which genetic information — and therefore biological characteristics — can persist relatively unchanged across millions of generations of organisms. The mechanism by which DNA is passed from one generation of cells to the next is a combination of DNA replication and cell division. In this unit, you will learn how DNA is first packaged and then passed on to the next generation during cell division. You will also explore the unpredictable ways in which DNA can change during this process.

- Introduction: How Does DNA Move from Cell to Cell?
- Replication and Distribution of DNA during Mitosis
- Replication and Distribution of DNA during Meiosis
- DNA Is Constantly Changing through the Process of Recombination
- DNA Is Constantly Changing through the Process of Mutation
- Some Sections of DNA Do Not Determine Traits, but Affect the Process of Transcription: Gene Regulation

## Unit 3: How Is Genetic Information Passed between Organisms?

Heredity, or the continuity of traits between parent and offspring, is powered by the physical transmission of DNA between cells during reproduction. In this unit, you will learn about the origins of our modern understanding of heredity, as well as the basic rules that determine how parents' traits determine the traits of their offspring.

- Introduction: How Is Genetic Information Passed between Organisms?
- Each Organism's Traits Are Inherited from a Parent through Transmission of DNA
- Inheritance of Traits by Offspring Follows Predictable Rules
- Some Genes Are Transmitted to Offspring in Groups via the Phenomenon of Gene Linkage
- The Sex of Offspring Is Determined by Particular Chromosomes
- Some Organisms Transmit Genetic Material to Offspring without Cell Division

## Unit 4: How Do Scientists Study and Manipulate the DNA inside Cells?

Although DNA is so extremely small that we are not able to see it with the naked eye, scientists have developed laboratory techniques to track DNA and even modify it. With these techniques, scientists can assess how active gene transcription is, and what conditions can change it. Scientists can also ask fundamental questions about multiple genes at the same time. In this unit, you will learn what these techniques are, how they are performed, and what they achieve.

- Introduction: How Do We Study the DNA Inside Cells?
- The Order of Nucleotides in a Gene Is Revealed by DNA Sequencing
- Scientists Can Make Copies of a Gene through PCR
- Scientists Can Analyze Gene Function by Deleting Gene Sequences
- Gene Expression Is Analyzed by Tracking RNA
- Scientists Can Study an Organism's Entire Genome with Microarray Analysis

## Unit 5: How Does Inheritance Operate at the Level of Whole Populations?

Because DNA passes from parent to offspring, there is generally significant genetic similarity between the organisms in a population,

provided that the members of this population have descended from common ancestors. For example, although human beings have existed for 200,000 years, there is a less than 0.1% difference (called genetic variability) between the DNA of even the most dissimilar human beings. Nonetheless, the collective genetic makeup of entire populations can change significantly over time. The study of how this happens among both humans and other organisms is called population genetics. In this unit, you will learn how the underlying genetic variability of a population emerges, as well as how and why the collective genetic makeup of a population can change.

- Introduction: How Does Inheritance Operate at the Level of Whole Populations?
- The Collective Set of Alleles in a Population Is Its Gene Pool
- The Variety of Genes in the Gene Pool Can Be Quantified within a Population
- The Genetic Variation in a Population Is Caused by Multiple Factors
- Genomics Enables Scientists to Study Genetic Variability in Human Populations

## Topic Rooms

(<http://www.nature.com/scitable/topics>)

## Genetics

(<http://www.nature.com/scitable/topic/genetics-5>)

To better inform our decisions at the doctor, the grocery store, and at home, it is crucial for us to know something about genetics. As we cultivate this understanding, we need to explore the evidence that supports our modern knowledge of genetics.

## Available Articles

- Women in Science Forum
- Barbara McClintock: The Secret of Maize
- Cells Can Replicate Their DNA Precisely
- Discovery of the Function of DNA Resulted from the Work of Multiple Scientists
- DNA Is a Structure That Encodes Biological Information
- DNA Is Constantly Changing through the Process of Mutation
- DNA Is Constantly Changing through the Process of Recombination

- Each Organism's Traits Are Inherited from a Parent through Transmission of DNA
- Francis Crick: The Secret of Life
- Frederick Sanger: Method Man, Problem Solver
- Gene Expression Is Analyzed by Tracking RNA
- Genomics Enables Scientists to Study Genetic Variability in Human Populations
- Gregor Mendel: A Private Scientist
- Inheritance of Traits by Offspring Follows Predictable Rules
- Introduction: How Do We Study the DNA Inside Cells?
- Introduction: How Does DNA Move from Cell to Cell?
- Introduction: How Does Inheritance Operate at the Level of Whole Populations?
- Introduction: How Is Genetic Information Passed between Organisms?
- Introduction: What Is DNA?
- James Watson: Genetics Impresario
- Linus Pauling: A Lifetime of Science
- Maurice Wilkins: Behind the Scenes of DNA
- Nettie Stevens: A Discoverer of Sex Chromosomes
- Replication and Distribution of DNA during Meiosis
- Replication and Distribution of DNA during Mitosis
- Rosalind Franklin: A Crucial Contribution
- Scientists Can Analyze Gene Function by Deleting Gene Sequences
- Scientists Can Make Copies of a Gene through PCR
- Scientists Can Study an Organism's Entire Genome with Microarray Analysis
- Some Genes Are Transmitted to Offspring in Groups via the Phenomenon of Gene Linkage
- Some Organisms Transmit Genetic Material to Offspring without Cell Division
- Some Sections of DNA Do Not Determine Traits, but Affect the Process of Transcription: Gene Regulation
- The Collective Set of Alleles in a Population Is Its Gene Pool
- The Genetic Variation in a Population Is Caused by Multiple Factors
- The Information in DNA Determines Cellular Function via Translation
- The Information in DNA Is Decoded by Transcription
- The Order of Nucleotides in a Gene Is Revealed by DNA Sequencing
- The Sex of Offspring Is Determined by Particular Chromosomes
- The Variety of Genes in the Gene Pool Can Be Quantified within a Population
- Thomas Hunt Morgan: The Fruit Fly Scientist

## Chromosomes and Cytogenetics

(<http://www.nature.com/scitable/topic/chromosomes-and-cytogenetics-7>)

Cytogenetics is the study of chromosomes and their role in heredity. Thus, this topic room is all about chromosomes: chromosome structure and composition, the methods that scientists use to analyze chromosomes, chromosome abnormalities associated with disease, the roles that chromosomes play in sex determination, and changes in chromosomes during evolution.

### Chromosome Analysis (10 Articles)

- Chromosome Mapping: Idiograms
- Fluorescence In Situ Hybridization (FISH)
- Chromosome Territories: The Arrangement of Chromosomes in the Nucleus
- Human Chromosome Translocations and Cancer
- Karyotyping for Chromosomal Abnormalities
- Cytogenetic Methods and Disease: Flow Cytometry, CGH, and FISH
- Prenatal Screen Detects Fetal Abnormalities
- Microarray-based Comparative Genomic Hybridization (aCGH)
- Diagnosing Down Syndrome, Cystic Fibrosis, Tay-Sachs Disease, and Other Genetic Disorders
- Synteny: Inferring Ancestral Genomes

### Chromosome Number (4 Articles)

- Chromosomal Abnormalities: Aneuploidies
- Polyploidy
- Human Chromosome Number
- Trisomy 21 Causes Down Syndrome

### Chromosome Structure (6 Articles)

- Chromosome Mapping: Idiograms
- DNA Packaging: Nucleosomes and Chromatin
- Telomeres of Human Chromosomes
- Chromosome Territories: The Arrangement of Chromosomes in the Nucleus

- Chromosome Segregation in Mitosis: The Role of Centromeres
- Genome Packaging in Prokaryotes: the Circular Chromosome of E. coli

## Mutations and Alterations in Chromosomes (13 Articles)

- Chromosomal Abnormalities: Aneuploidies
- DNA Deletion and Duplication and the Associated Genetic Disorders
- Human Chromosome Number
- Chromosome Abnormalities and Cancer Cytogenetics
- Human Chromosome Translocations and Cancer
- X Chromosome: X Inactivation
- Trisomy 21 Causes Down Syndrome
- Karyotyping for Chromosomal Abnormalities
- Cytogenetic Methods and Disease: Flow Cytometry, CGH, and FISH
- Prenatal Screen Detects Fetal Abnormalities
- Genetic Recombination
- Synteny: Inferring Ancestral Genomes
- Copy Number Variation and Human Disease

## Sex Chromosomes (5 Articles)

- Genetic Mechanisms of Sex Determination
- Sex Chromosomes in Mammals: X Inactivation
- Sex determination in honeybees
- X Chromosome: X Inactivation
- Sex Chromosomes and Sex Determination

## Chromosome Theory and Cell Division (5 Articles)

- Chromosome Theory and the Castle and Morgan Debate
- Developing the Chromosome Theory
- Chromosome Segregation in Mitosis: The Role of Centromeres
- Mitosis and Cell Division
- Meiosis, Genetic Recombination, and Sexual Reproduction

## Evolutionary Genetics

(<http://www.nature.com/scitable/topic/evolutionary-genetics-13>)

Those articles that are part of the evolutionary genetics topic room can be arbitrarily divided into five main categories: phylogenetics; mutation and molecular population genetics; the genetics of speciation; genome evolution; and evolution and development (also known as evo-devo).

### Genome Evolution (1 Article)

- Origins of New Genes and Pseudogenes

### Macroevolution (1 Article)

- The Molecular Clock and Estimating Species Divergence

### Microevolution (7 Articles)

- Sexual Reproduction and the Evolution of Sex
- Neutral Theory: The Null Hypothesis of Molecular Evolution
- Negative Selection
- Evolutionary Adaptation in the Human Lineage
- Natural Selection: Uncovering Mechanisms of Evolutionary Adaptation to Infectious Disease
- Negative Selection
- Genetic Mutation

### Phylogeny (2 Articles)

- Trait Evolution on a Phylogenetic Tree: Relatedness, Similarity, and the Myth of Evolutionary Advancement
- Reading a Phylogenetic Tree: The Meaning of Monophyletic Groups

### Speciation (4 Articles)

- Hybrid Incompatibility and Speciation
- Haldane's Rule: the Heterogametic Sex
- Hybridization and Gene Flow
- Why Should We Care about Species?

## Gene Expression and Regulation

(<http://www.nature.com/scitable/topic/gene-expression-and-regulation-15>)

This topic room begins by showing how a quiet, well-guarded string of DNA is expressed to make RNA, and how the messenger RNA is translated from nucleic acid coding to protein coding to form a protein. Along the way, the room also examines the nature of the genetic code, how the elements of code were predicted, and how the actual codons were determined.

### Transcription Factors (7 Articles)

- Hox Genes in Development: The Hox Code
- Genetic Signaling: Transcription Factor Cascades and Segmentation
- Do Transcription Factors Actually Bind DNA? DNA Footprinting and Gel Shift Assays
- Transcription Factors and Transcriptional Control in Eukaryotic Cells
- Gradient-Based DNA Transcription Control in Animals
- The Complexity of Gene Expression, Protein Interaction, and Cell Differentiation
- Gene Expression Regulates Cell Differentiation

### From DNA to Protein (6 Articles)

- Discovering the Relationship Between DNA and Protein Production
- Reading the Genetic Code
- Translation: DNA to mRNA to Protein
- Nucleic Acids to Amino Acids: DNA Specifies Protein
- Simultaneous Gene Transcription and Translation in Bacteria
- DNA Transcription

### Regulation of Transcription (7 Articles)

- Operons and Prokaryotic Gene Regulation
- Negative Transcription Regulation in Prokaryotes
- Positive Transcription Control: The Glucose Effect
- Regulation of Transcription and Gene Expression in Eukaryotes
- Transcription Factors and Transcriptional Control in Eukaryotic Cells
- The Role of Methylation in Gene Expression



- Gene Expression Regulates Cell Differentiation

## Organization of Chromatin (5 Articles)

- The Complexity of Gene Expression, Protein Interaction, and Cell Differentiation
- Chromatin Remodeling in Eukaryotes
- Chromatin Remodeling and DNase 1 Sensitivity
- Examining Histone Modifications with Chromatin Immunoprecipitation and Quantitative PCR
- The Role of Methylation in Gene Expression

## RNA (5 Articles)

- Small Non-coding RNA and Gene Expression
- RNA Transcription by RNA Polymerase: Prokaryotes vs Eukaryotes
- mRNA: History of Functional Investigation
- The Role of Ribosomes in Protein Synthesis
- RNA Functions

## Gene Responses to Environment (9 Articles)

- Environmental Influences on Gene Expression
- Environmental Cues Like Hypoxia Can Trigger Gene Expression and Cancer Development
- Environment Controls Gene Expression: Sex Determination and the Onset of Genetic Disorders
- The Complexity of Gene Expression, Protein Interaction, and Cell Differentiation
- Environmental Mutagens, Cell Signalling and DNA Repair
- Environmental Factors Like Viral Infections Play a Role in the Onset of Complex Diseases
- Obesity, Epigenetics, and Gene Regulation
- Genes, Smoking, and Lung Cancer
- Gene Expression Regulates Cell Differentiation

## Consequences of Gene Regulation (9 Articles)

- Gene Interaction and Disease
- Genetic Control of Aging and Life Span
- Obesity, Epigenetics, and Gene Regulation
- Genetic Diagnosis: DNA Microarrays and Cancer
- Genetic Imprinting and X Inactivation
- Imprinting and Genetic Disease: Angelman, Prader-Willi, and Beckwith-Wiedemann Syndromes
- Atavism: Embryology, Development and Evolution
- Genetic Regulation of Cancer
- Epistasis: Gene Interaction and the Phenotypic Expression of Complex Diseases Like Alzheimer's

## Gene Inheritance and Transmission

(<http://www.nature.com/scitable/topic/gene-inheritance-and-transmission-23>)

Transmission genetics is the study of how genes are passed from one generation to the next. The articles in this room explore a wide range of topics in classical genetics. They also illustrate how the analytical power of gene inheritance combined with the molecular approaches covered in the other topic rooms help us to understand some of the most complex problems in genetics.

## The Foundation of Inheritance Studies (11 Articles)

- Non-nuclear Genes and Their Inheritance
- Multifactorial Inheritance and Genetic Disease
- Gregor Mendel and the Principles of Inheritance
- Genetic Recombination
- Mitosis, Meiosis, and Inheritance
- Developing the Chromosome Theory
- Test Crosses
- Sex Chromosomes and Sex Determination
- Mendelian Genetics: Patterns of Inheritance and Single-Gene Disorders
- Sex determination in honeybees
- Polygenic Inheritance and Gene Mapping

## Gene Linkage (5 Articles)

- Thomas Hunt Morgan and Sex Linkage
- Chromosome Theory and the Castle and Morgan Debate
- Thomas Hunt Morgan, Genetic Recombination, and Gene Mapping
- Discovery and Types of Genetic Linkage
- Genetics and Statistical Analysis

## Variation in Gene Expression (6)

- Pleiotropy: One Gene Can Affect Multiple Traits
- Phenotype Variability: Penetrance and Expressivity
- Genetic Dominance: Genotype-Phenotype Relationships
- Environmental Influences on Gene Expression
- Phenotypic Range of Gene Expression: Environmental Influence
- Epistasis: Gene Interaction and Phenotype Effects

## Methods for Studying Inheritance Patterns (7)

- Mapping Genes to Chromosomes: Linkage and Genetic Screens
- Paternity Testing: Blood Types and DNA
- Mendelian Ratios and Lethal Genes
- Biological Complexity and Integrative Levels of Organization
- Human Evolutionary Tree
- C. elegans: Model Organism in the Discovery of PKD
- Genetics of Dog Breeding

## Genes and Disease

(<http://www.nature.com/scitable/topic/genes-and-disease-17>)

Understanding the role of genetics in disease has become a central part of medical research. As such, the articles in this topic room explore the complex relationship between human genetics and various disease states. This room examines current medical research and tools targeting these conditions in the effort to better treat or prevent them.

## Epigenetics and Disease (2 Articles)

- Epigenetic Influences and Disease

- Epistasis: Gene Interaction and the Phenotypic Expression of Complex Diseases Like Alzheimer's

## Genetic Origin of Disease (7 Articles)

- Mendelian Genetics: Patterns of Inheritance and Single-Gene Disorders
- Genomic Imprinting and Patterns of Disease Inheritance
- Same Genetic Mutation, Different Genetic Disease Phenotype
- Complex Diseases: Research and Applications
- Gene Interaction and Disease
- mtDNA and Mitochondrial Diseases
- DNA Deletion and Duplication and the Associated Genetic Disorders

## Tracking Disease Inheritance (5 Articles)

- Multifactorial Inheritance and Genetic Disease
- Complex Diseases: Research and Applications
- Gene Interaction and Disease
- Gene Mapping and Disease
- Polygenic Inheritance and Gene Mapping

## The Genetics of Microbes (4 Articles)

- Antibiotic Resistance, Mutation Rates and MRSA
- Genetics of the Influenza Virus
- Genetic Origins of Microbial Virulence
- Pathogenicity: Microbial Virulence

## The Genetic Basis of Cancer (10 Articles)

- Genetic Causes of Adult-Onset Disorders
- Chromosome Abnormalities and Cancer Cytogenetics
- Genetic Regulation of Cancer
- Proto-oncogenes to Oncogenes to Cancer
- Tumor Suppressor (TS) Genes and the Two-Hit Hypothesis
- Genetic Diagnosis: DNA Microarrays and Cancer

- Human Chromosome Translocations and Cancer
- L. H. Hartwell's Yeast: A Model Organism for Studying Somatic Mutations and Cancer
- Genes, Smoking, and Lung Cancer
- Gleevec: The Breakthrough in Cancer Treatment

## Identifiable Genetic Disease (9 Articles)

- Genetic Causes of Adult-Onset Disorders
- Birth Defects: Prevention and Treatment
- Birth Defects: Causes and Statistics
- Trisomy 21 Causes Down Syndrome
- Somatic Mosaicism and Chromosomal Disorders
- Huntington's Disease: The Discovery of the Huntingtin Gene
- Sex-linked Diseases: The Case of Duchenne Muscular Dystrophy (DMD)
- Copy Number Variation and Genetic Disease
- Embryo Screening and the Ethics of Human Genetic Engineering

## The Study of Genetics and Disease (15)

- Rare Genetic Disorders: Learning About Genetic Disease Through Gene Mapping, SNPs, and Microarray Data
- Gene-Based Therapeutic Approaches
- Cytogenetic Methods in Diagnosing Genetic Disorders
- Cytogenetic Methods and Disease: Flow Cytometry, CGH, and FISH
- Personalized Medicine: Hope or Hype?
- Genetic Diagnosis: DNA Microarrays and Cancer
- L. H. Hartwell's Yeast: A Model Organism for Studying Somatic Mutations and Cancer
- The Use of Animal Models in Studying Genetic Disease: Transgenesis and Induced Mutation
- Genome-Wide Association Studies (GWAS) and Obesity
- Using SNP Data to Examine Human Phenotypic Differences
- Genome-Wide Association Studies and Human Disease Networks
- Genetic Variation and Disease: GWAS
- Embryo Screening and the Ethics of Human Genetic Engineering
- Polygenic Inheritance and Gene Mapping
- Ontologies: Scientific Data Sharing Made Easy

## Genetics and Society

(<http://www.nature.com/scitable/topic/genetics-and-society-11>)

This topic room covers the ethical, legal, and social implications (ELSI) of genetic advances and their applications. To lay a foundation for ELSI discussions, this collection of articles explores the unique medical, ethical and legal issues encountered in genetic diseases, and the profound impact genetic conditions have at the individual, family, and societal levels.

### Genetic Diagnosis and Disease Risks (5 Articles)

- Diagnosing Down Syndrome, Cystic Fibrosis, Tay-Sachs Disease, and Other Genetic Disorders
- Genetic Counseling: Genetic Testing, Family History, and Psychosocial Evaluation
- Calculation of Complex Disease Risk
- Genetic Variation and Disease: GWAS
- Genetic Diagnosis: DNA Microarrays and Cancer

### Genetic Testing and Human Impact (8 Articles)

- Prenatal Screen Detects Fetal Abnormalities
- DTC Genetic Testing: 23andme, DNA Direct and Genelex
- DTC Genetic Testing for Diabetes, Breast Cancer, Heart Disease and Paternity
- Genetic Inequality: Human Genetic Engineering
- Human Subjects and Diagnostic Genetic Testing
- Heritability of Human Intelligence: IQ and Eugenics
- Human Testing, the Eugenics Movement, and IRBs
- Questionable Prognostic Value of Genetic Testing

### Ethical Considerations (9 Articles)

- Medical Ethics: Genetic Testing and Spinal Muscular Atrophy
- Genetic Inequality: Human Genetic Engineering
- Human Testing, the Eugenics Movement, and IRBs
- Bioethics in Genetics
- Diagnostic Testing and the Ethics of Patenting DNA

- Embryo Screening and the Ethics of Human Genetic Engineering
- Protecting Your Genetic Identity: GINA and HIPAA
- Questionable Prognostic Value of Genetic Testing
- Ethics of Genetic Testing: Medical Insurance and Genetic Discrimination

### Genetically-Tailored Treatment (6 Articles)

- Pharmacogenomics and Personalized Medicine
- Pharmacogenetics, Personalized Medicine, and Race
- Gene Therapy
- Controversies in Treatment Approaches: Gene Therapy, IVF, Stem Cells, and Pharmacogenomics
- Personalized Medicine: Hope or Hype?
- Using SNP Data to Examine Human Phenotypic Differences

### Social Uses of Genetic Discovery (7 Articles)

- Genetic Inequality: Human Genetic Engineering
- Forensics, DNA Fingerprinting, and CODIS
- Paternity Testing: Blood Types and DNA
- Genetically Modified Organisms (GMOs): Transgenic Crops and Recombinant DNA Technology
- Medical Careers: Genetic Screening and Diagnostics
- Sports, Gene Doping, and WADA
- Ontologies: Scientific Data Sharing Made Easy

### Genetics and the Law (5 Articles)

- Diagnostic Testing and the Ethics of Patenting DNA
- Protecting Your Genetic Identity: GINA and HIPAA
- Forensics, DNA Fingerprinting, and CODIS
- Forensics, DNA Fingerprinting, and CODIS
- Legislative Landmarks of Forensics: California v. Greenwood and Shed DNA
- Sports, Gene Doping, and WADA

## Genomics

(<http://www.nature.com/scitable/topic/genomics-19>)

A genome is an organism's complete set of genetic material. Thus, genomics is genetics on a huge scale, including information about vast numbers of genes and DNA sequences from scores of organisms. The articles in this room explore genomics-based methods for the study of genetic variation, the value of genomic data, and of course, the politics surrounding the uses of genomic data.

### Comparative Genomics (5 Articles)

- Genomes of Other Organisms: DNA Barcoding and Metagenomics
- Interpreting Shared Characteristics: The Platypus Genome
- Pufferfish and Ancestral Genomes
- Simple Viral and Bacterial Genomes
- Microarray-based Comparative Genomic Hybridization (aCGH)

### Genome Sequencing and Annotation (6 Articles)

- Complex Genomes: Shotgun Sequencing
- DNA Sequencing Technologies
- DNA Sequencing Technologies Key to the Human Genome Project
- Genomic Data Resources: Challenges and Promises
- Sequencing Human Genome: the Contributions of Francis Collins and Craig Venter
- Basic Local Alignment Search Tool (BLAST)

### Functional Genomics (4 Articles)

- Ontologies: Scientific Data Sharing Made Easy
- Microarray-based Comparative Genomic Hybridization (aCGH)
- The Proteome: Discovering the Structure and Function of Proteins
- Transcriptome: Connecting the Genome to Gene Function

### Translational Genomics (6 Articles)



- Behavioral Genomics
- Comparative Methylation Hybridization
- DNA Fingerprinting Using Amplified Fragment Length Polymorphisms (AFLP)
- Epigenomics: The New Tool in Studying Complex Diseases
- Sustainable Bioenergy: Genomics and Biofuels Development
- Pharmacogenomics and Personalized Medicine

## Nucleic Acid Structure and Function

(<http://www.nature.com/scitable/topic/nucleic-acid-structure-and-function-9>)

The articles in this topic room describe the science surrounding the structure and function of DNA. Here, you will find information on the chemical structure of DNA; organization of DNA into chromosomes, genes, and gene families; the processes of DNA replication, transcription, and translation; as well techniques related to manipulation of the genetic sequence.

### DNA Replication (6 Articles)

- DNA Replication and Causes of Mutation
- Major Molecular Events of DNA Replication
- Semi-Conservative DNA Replication: Meselson and Stahl
- Genetic Mutation
- DNA Damage & Repair: Mechanisms for Maintaining DNA Integrity
- Genetic Mutation

### Transcription & Translation (4 Articles)

- Translation: DNA to mRNA to Protein
- DNA Transcription
- RNA Transcription by RNA Polymerase: Prokaryotes vs Eukaryotes
- What is a Gene? Colinearity and Transcription Units

### Discovery of Genetic Material (4 Articles)

- Isolating Hereditary Material: Frederick Griffith, Oswald Avery, Alfred Hershey, and Martha Chase
- Discovery of DNA as the Hereditary Material using *Streptococcus pneumoniae*
- Discovery of DNA Structure and Function: Watson and Crick
- Barbara McClintock and the Discovery of Jumping Genes (Transposons)

## RNA (8 Articles)

- RNA Functions
- RNA Transcription by RNA Polymerase: Prokaryotes vs Eukaryotes
- Chemical Structure of RNA
- RNA Splicing: Introns, Exons and Spliceosome
- What is a Gene? Colinearity and Transcription Units
- Restriction Enzymes
- Genome Packaging in Prokaryotes: the Circular Chromosome of *E. coli*
- Eukaryotic Genome Complexity

## Gene Copies (5 Articles)

- Copy Number Variation and Genetic Disease
- DNA Deletion and Duplication and the Associated Genetic Disorders
- Tandem Repeats and Morphological Variation
- Copy Number Variation
- Copy Number Variation and Human Disease

## Jumping Genes (4 Articles)

- Transposons: The Jumping Genes
- Barbara McClintock and the Discovery of Jumping Genes (Transposons)
- Transposons, or Jumping Genes: Not Junk DNA?
- Functions and Utility of Alu Jumping Genes

## Applications in Biotechnology (4 Articles)

- Recombinant DNA Technology and Transgenic Animals

- Genetically Modified Organisms (GMOs): Transgenic Crops and Recombinant DNA Technology
- The Biotechnology Revolution: PCR and the Use of Reverse Transcriptase to Clone Expressed Genes
- Antibiotic Resistance, Mutation Rates and MRSA

## Population and Quantitative Genetics

(<http://www.nature.com/scitable/topic/population-and-quantitative-genetics-21>)

Population and quantitative genetics focus on the genetic basis of variation among the individuals in a population. Population genetics focuses on allele and genotype frequencies, whereas quantitative genetics focuses on the ways that variation in genotype and environment contribute to variance in phenotype among individuals. The articles in this room address both subjects.

## Conservation and Ecological Genetics (1 Article)

- Genetic Drift: Bottleneck Effect and the Case of the Bearded Vulture

## Introduction to Quantitative Genetics (3 Articles)

- Adaptation and Phenotypic Variance
- Dimorphisms and Threshold Traits
- Estimating Trait Heritability

## Quantitative Trait Loci (3 Articles)

- Human Genomic Epidemiology: HuGENet
- Quantitative Genetics: Growing Transgenic Tomatoes
- Quantitative Trait Locus (QTL) Analysis

## Wright-Fisher Populations (3)

- Sewall Wright and the Development of Shifting Balance Theory

- Genetic Drift and Effective Population Size
- The EvolGenius Population Genetics Computer Simulation: How it Works

## Spotlights

(<http://www.nature.com/scitable/topics>)

## Doping in Sports

(<http://www.nature.com/scitable/spotlight/doping-in-sports-7005401>)

The use of synthetic drugs to enhance athletic performance, commonly referred to as doping, has exploded in recent decades. As newer methods for doping emerge, researchers must respond with tests capable of detecting them. This tug-of-war between dopers and testers has advanced the science of human physiology and drug testing significantly. Who is winning in this high-stakes competition?

## What is doping?

- Commonly used drugs in sports
- The science behind gene doping
- The dangers of doping

## Attempts at Regulation

- US Congress and steroids
- WADA's regulation of doping in international competition
- How well do you know WADA's anti-doping code?

## How is doping detected?

- A timeline of doping and drug testing in the last half century
- A quick video about doping and drug testing in sports
- The development of a test for human Growth Hormone (hGH)

## Ethics of doping in competition

- The doping dilemma
- The age-old practice of doping animals
- Who is using steroids?

## Major doping scandals in recent history

- State-sponsored doping in the Olympics
- Discover how doping changed Major League Baseball
- Suspicions of cheating can frustrate athletes

## Autism

(<http://www.nature.com/scitable/spotlight/autism-8277315>)

Unlike so many infectious diseases, reported cases of autism are actually on the rise in the 21st century. As a result, the question of what causes autism is an increasingly crucial one for our society to answer. Is autism caused by genetic factors or by a child's social environment? To what extent do changing standards of diagnosis affect the reported rate of occurrence?

## What is autism?

- The facts about autism
- How is autism diagnosed?
- What are Autism Spectrum Disorders?

## Treatments for autism

- Medication for children
- Behavioral treatment for children
- Adult treatments

## Living with autism

- The Autism Rights Movement
- The language of autism
- Meet Temple Grandin
- Perhaps it's not about a cure
- The advantages of autism
- An interview with Temple Grandin

## Facts and Figures about Autism

- Autism prevalence in the US
- The cost of care
- Current clinical research

## Autism and vaccines

- What is thimerosal?
- CDC on vaccine safety
- A formal retraction

## The H1N1 Virus

(<http://www.nature.com/scitable/spotlight/the-h1n1-virus-6902675>)

No illness has dominated international headlines recently like the A-H1N1 virus, also known as the "swine flu." In early 2009, the emergence of A-H1N1 effectively shut down the Mexican economy and created widespread fear. By mid-2009, the virus had spread to become a global pandemic. How should the world's governments respond to this crisis?

### What is it?

- Three key questions
- Get the "Big Picture" on the H1N1 virus
- It may not be as deadly as we thought

## Vaccination Resources

- The US government's website on the seasonal flu, H1N1, and locating vaccines
- Distribution and safety of vaccines
- Are vaccines safe?

## H1N1 Across the Globe

- Populations at risk
- The geography of H1N1
- Stay up-to-date on the global threat
- Health risks depend on where you go and what you do
- Countries are addressing outbreaks differently
- State-level response to the H1N1 virus

## Social and economic impact

- Some health care workers are refusing vaccinations
- Why could H1N1 be costly for businesses?
- Misinformation and misconception about H1N1

## Stem Cells

(<http://www.nature.com/scitable/spotlight/stem-cells-6969855>)

The use of stem cells in scientific research and medical treatments has sparked controversy because some stem cells are derived from human embryos. Nevertheless, the medical benefits derived from stem cell research are potentially significant. Should governments publicly fund stem cell research, as they fund many other kinds of therapeutic research? Should ethical concerns prevent scientists from conducting such research?

## What are stem cells?

- NOVA's introduction to stem cells
- Stem cell discovery in bone marrow
- A primer on stem cells from NIH

## How are stem cells manufactured?

- The National Stem Cell Bank hosted by WiCell
- Non-embryonic resources: induced pluripotent stem (iPS) cells
- Stem cells can come from fat cells

## How are stem cells used in medicine?

- Inside a stem cell transplant
- Stem cell cloning for therapeutic use
- Guide to stem cell therapy

## The government landscape

- President Obama reversed the ban on stem cell research
- The National Science Advisor on the benefits of stem cells
- Federal support has created the "Stem Cell Unit" at the NIH

## Ethics of stem cell research

- In favor of stem cell use
- Against stem cell use
- What is your opinion?