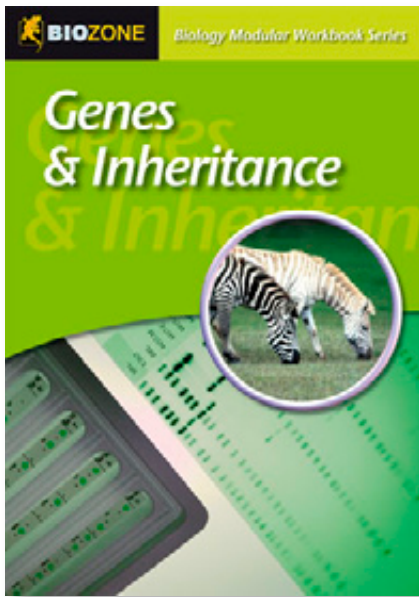


Genes & Inheritance



Genes & Inheritance

A seamless integration of fundamental concepts and new information, Genes & Inheritance offers students ample opportunity to both consolidate and extend their knowledge in the rapidly developing areas of molecular genetics and Mendelian and non-Mendelian inheritance.

Suitability:

- Grades 10-12
- Community College

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Biozone's unique formula encourages self direction, while dovetailing with traditional resources.

Chapters

- Molecular Genetics
- Control of Gene Expression
- Genes and Chromosomes
- Mutations
- Inheritance

Features

- **Introduction to the topic:**
A concise introduction to the concepts in the activity.
- **Easy to understand diagrams:**
Highly visual, clearly annotated diagrams improve the accessibility of information.
- **Consolidation and branching out:**
Activities provide information to consolidate basic knowledge, while allowing scope for exploring. Differential instruction becomes easier and students at all levels are encouraged to be 'thinkers'.
- **Write-on format:**
Activities provide information to consolidate basic knowledge, while allowing scope for exploring.
- **Tear-out pages:**
Each page has a perforation to allow easy removal for marking, or placement in a ring binder.
- **Activity Code:**
Each activity is coded to identify the skills required for its completion.

Transcription

Introduction: In the process of what the code is written to the flow of information from DNA to a single molecule of messenger RNA (mRNA) is called transcription. Transcription is the process of copying the genetic code from DNA to mRNA. The genetic code is a set of instructions that tells the cell how to make a protein. The instructions are written in the form of a sequence of three bases, called a codon. Each codon codes for a specific amino acid. The sequence of amino acids in a protein determines its shape and function.

Activity: A diagram shows a DNA double helix being unwound. One strand is used as a template to synthesize a complementary mRNA strand. The mRNA strand is then shown being translated into a protein chain. The genetic code is shown as a table of codons and their corresponding amino acids.

Questions:

1. Explain the role of messenger RNA in protein synthesis.
2. The genetic code contains a start codon (AUG) and a stop codon (UAG). What is the role of each?
3. For the following DNA sequence, determine the complementary mRNA sequence that must be synthesized.

ATG	ATG	ATG	ATG	ATG	ATG
-----	-----	-----	-----	-----	-----
4. For the following mRNA sequence, determine the complementary DNA sequence that must be synthesized.

ATG	ATG	ATG	ATG	ATG	ATG
-----	-----	-----	-----	-----	-----

Code: BA 2

Epistasis

Introduction: In the human system, epistasis occurs when one gene masks the effect of another. This is often seen in the case of coat color in mice. The gene for black coat color (B) is dominant to the gene for brown coat color (b). However, the gene for white coat color (C) is dominant to both B and b. This means that if a mouse has the C allele, it will be white, regardless of the B or b allele it has.

Activity: A diagram shows a cross between a black mouse (BBcc) and a white mouse (bbCC). The offspring are all black (BbCc). A Punnett square is provided for the cross.

Questions:

1. State how many offspring are possible for a given genotype.
2. State what alleles are present for the following genotypes:
 - Black: $BbCc$
 - White: $bbCC$
3. Complete the Punnett square for the right by adding the genotype and phenotype for each possible offspring. (Remember the order of the chromosomes for the type of cross.)

Code: A 3

The Fate of Conceptions

Introduction: A significant number of conceptions do not survive to become children. This is due to a variety of factors, including chromosomal abnormalities, genetic defects, and environmental factors. The fate of conceptions is often determined by the sex chromosomes they inherit. For example, conceptions with a Y chromosome (male) are more likely to survive than those with an X chromosome (female).

Activity: A diagram shows the process of fertilization and the resulting zygote. A graph shows the percentage of conceptions that survive to birth, with a significant drop-off for male conceptions. A table shows the relative number of conceptions that survive to birth for different genotypes.

Questions:

1. Discuss the role of the maternal age effect in the incidence rate of Down syndrome and other chromosomal disorders.
2. Explain the role of sex chromosomes in determining the sex of offspring.
3. Explain why, in general, more female conceptions survive to birth than male conceptions.

Code: BA 2

Cystic Fibrosis Mutation

Introduction: Cystic fibrosis is a genetic disorder caused by a mutation in the CFTR gene. The mutation results in a protein that is either missing or defective, leading to a variety of symptoms, including difficulty breathing and frequent lung infections. The CFTR gene is located on chromosome 7.

Activity: A diagram shows the CFTR gene and the resulting protein. A Punnett square is provided for a cross between two carriers (Cc). A table shows the relative number of conceptions that survive to birth for different genotypes.

Questions:

1. Write the mRNA sequence for the following DNA strand:

ATG	ATG	ATG	ATG	ATG	ATG
-----	-----	-----	-----	-----	-----
2. Use the mRNA sequence and base-pairing rules to determine the amino acid sequence coded by the mRNA for the beginning of the protein. Write the amino acid sequence in the space provided.
3. Explain the role of the CFTR protein in the cell. How does a mutation in the CFTR gene affect the protein's function?
4. Identify the amino acid that has been released from the protein by this mutation.
5. Suggest why cystic fibrosis is a disease with varying degrees of severity.

Code: BA 3

Genes & Inheritance

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 The Fate of Conceptions

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Genomic Imprinting

The phenotypic effects of some mammalian genes depend on whether they were inherited from the mother or the father. This phenomenon, called **genomic imprinting** (or **parental imprinting**), is part of epigenetics, the study of the heritable changes in gene function that occur without involving changes in the DNA sequence. Just as cells inherit genes, they also inherit the instructions that determine to the genes when to become active, in which tissue, and to what extent. Epigenetic phenomena are important because they regulate when and of what genes are expressed.

Genomic imprinting

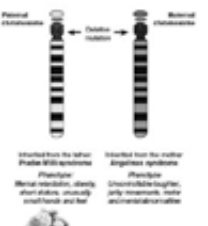
Genetic imprinting describes how a small subset of the genes in the genome are expressed according to their parent of origin. Imprinting can act as silencers or activators for imprinted genes. A maternal allele has one set of chromosomes, and the paternal one from the father to bring the imprinted gene expression in contrast to a recessive or a dominant allele.



Maternal and paternal chromosomes are differentially imprinted. Chromosomes are being imprinted (methylated) in the embryo.

Imprinted Genes Are Different

Some imprinted genes are expressed from a maternally inherited chromosome and others from a paternally inherited chromosome, while other imprinted genes show the opposite expression pattern and are only expressed from a paternally inherited chromosome. Evidence of this is seen in two human genetic disorders, both are caused by the same mutation: a specific deletion or chromosome 15. The disorder expressed depends on whether the mutation is inherited from the father or the mother.



Prader-Willi syndrome (paternal deletion) and Angelman syndrome (maternal deletion) are caused by the same mutation: a specific deletion or chromosome 15. The disorder expressed depends on whether the mutation is inherited from the father or the mother.

How Are Genes Silenced?

- In many instances, gene silencing is achieved through methylation of the DNA of genes or regulatory sequences, which results in the gene not being expressed.
- Methylation of genes is achieved by adding a methyl group to cytosine in the DNA. This changes the shape of the DNA molecule so that the expression of any genes in the imprinted region is inhibited. Methylation is also important in transcription.
- In other instances, phosphorylation or other chemical modification of histone proteins appears to be involved.

Which genes do you think have just mother control from your father? For your gene, imprinting will affect the gene expression.

- Explain what is meant by genomic imprinting.
- Describe one of the mechanisms by which imprinting is achieved.
- Explain the significance of imprinting to the inheritance of genes.

Code: A 3

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