Experiment worksheet answers

1.1 Scientists review the research of other scientists

Pages 2–3 and 180

Experiment 1.1: Extracting DNA

Discussion

1 Briefly describe the appearance of the DNA under the microscope. Why can you not see the double helix?

The DNA will be the cloudy, white, cotton-like layer that winds around the toothpick. DNA molecules are very small and can only be seen when wound up into chromosomes.

2 Do you think human DNA will look the same as the DNA from dried peas?

The amount of DNA present in cells of different species will vary, as will the order of the nucleotides. However, the DNA in every organism is made from the same four nucleotides with the same double-helical structure, including human DNA. Therefore, the DNA will have the same appearance.

3 What role does each of the additives (dishwashing detergent, meat tenderiser and alcohol) play?

Dishwashing detergent breaks up the membrane around the cells and the nuclear membrane surrounding the DNA in the peas. The meat tenderiser is a protease enzyme that breaks up the proteins (histones) that the DNA is wound around. DNA is not soluble in alcohol. Therefore, DNA will form a precipitate in the alcohol layer.

4 What materials remain in the watery layer?

The rest of the cell and its contents (including the proteins) will remain in the watery layer.

Experiment worksheet answers

1.2 DNA consists of a sugar-phosphate backbone and four complementary nitrogen bases

Pages 4–5 and 181

Challenge 1.2: Modelling the structure of DNA

Discussion

1 What colour beads represented:

a adenine

b thymine

c guanine

d cytosine

Students’ results will reflect the bead colours they chose.

2 What do the letters DNA stand for?

Deoxyribonucleic acid

3 Describe a “double helix”

A double helix is a twisted ladder. The phosphate-sugar backbone forms the sides of the ladder. The nitrogen bases are the rungs of a ladder.

4 Draw a single nucleotide from your model

Students’ results will reflect the bead colours they chose.

Experiment worksheet answers

1.3 Chromosomes are DNA molecules carrying genetic information in the form of genes

Pages 6–9 and 182

Skills lab 1.3: Making protein

A section of a DNA sequence made from a particular gene is shown below:

T A C T T A G A G A T G C T G A C T

1 Write down the complementary sequence of DNA for this part of the gene.

A T G A A T C T C T A C G A C T G A

2 If the strand shown is the template strand of the gene, write the RNA sequence that would be made. (Remember to use uracil instead of thymine.)

A U G A A U C U C U A C G A C U G A

3 Break the strand into groups of three. Each group is called a codon. Using the genetic code in Figure 1, write down the amino acids that the above sequence codes.

STOP, Asn, Leu, Tyr, Asp, STOP

4 How would the protein strand change if the 12th nucleotide in the DNA template strand (guanine) was changed to a thymine?

The 12th nucleotide in the RNA sequence would become A. This would change the codon from UAC to UAA. This then becomes a STOP and the resulting protein will be short.

Experiment worksheet answers

1.4 Mitosis forms new somatic cells

Pages 10–11 and 183

Skills lab 1.4: Cell division in action

3 Sketch at least four cells undergoing different stages of cell division. Remember the conventions for drawing biological images under the microscope. Clearly label all the components within the cell that you can identify correctly.

• DNA is visible under the microscope during interphase but not as individual chromosomes.

• What might be an advantage for DNA being tightly wound during mitosis?

The DNA is tightly wound to allow the chromosomes to be arranged and pulled to a pole without tangling.

• Describe the possible consequences for a cell if errors occur during the process of DNA replication that occurs during interphase.

Errors in the genes in DNA can cause a malformed, non-functioning protein to be produced. This may affect the function of the daughter cell.

• Explain the significance of mitosis for an organism.

Mitosis allows for the replacement and repair of damaged cells and the production of new cells for growth of the organism.

Experiment worksheet answers

1.5 Meiosis forms gamete cells

Pages 12–13 and 183

Challenge 1.5: Modelling meiosis

Discussion

1 How many sets of chromosomes does a cell have before it undergoes meiosis?

2 sets of chromosomes

2 How many sets of chromosomes does a cell have after it undergoes meiosis?

1 set of chromosomes

3 Why do gametes need to be haploid?

Each gamete contains a single (haploid) set of chromosomes. These gametes fuse during fertilisation and the resulting cell has two sets (diploid) of chromosomes. If gametes were not haploid, then the number of chromosomes would double for each generation.

Experiment worksheet answers

1.6 Alleles can produce dominant or recessive traits

Pages 14–15 and 184

Experiment 1.6: Zazzle genetics

Discussion

1 How many chromosomes were present in each of the:

a mother’s somatic cells?

12

b father’s gametes?

6

c baby Zazzle cells?

12

2 Write down your baby Zazzle’s genotype for each trait.

Students’ answers will vary.

3 Why does the baby Zazzle have two alleles for each trait?

One allele will come from the mother and the other will come from the father.

4 Draw a diagram of your baby Zazzle.

Students’ answers will vary.

Conclusion

Describe how dominant and recessive traits are inherited.

Students’ answers will vary. Key points that should be included are:

• Each baby will receive half their genetic material from their mother and half from their father.

• If both alleles for the recessive trait are inherited, then that trait will appear in the phenotype.

• If one or two alleles for the dominant trait is inherited, then that trait will appear in the phenotype.

Experiment worksheet answers

1.7 Alleles for blood group traits co-dominate

Pages 16–17 and 185

Experiment 1.7: Blood typing experiment

Discussion

1 What possible genotype(s) could the following people have?

a Person with blood group A

 or 

b Person with blood group B

 or 

c Person with blood group AB



d Person with blood group O



2 Could a person with blood group AB have a child with blood type O? Explain your answer.

No. A person with blood group AB will have the genotype . This means they must pass on either an  or an . Therefore they cannot have a child with blood group O (ii).

3 A child with blood group O claimed that she was adopted because her mother had blood group A and father had blood group B. How would you explain that this is still possible?

Mother might be and father might be . Therefore the child will have received one i from their mother and one i from their father.

Conclusion

How is blood grouping inherited?

Student’s results will vary. Key points that should be included are;

• Red blood cells may display sugars ‘A’ or ‘B’ or no sugars on their surface.

• A gene can produce an enzyme that results in the ‘A’ or ‘B’ or no sugar being produced.

• Alleles for this gene codominate.

Experiment worksheet answers

1.8 Alleles on the sex chromosomes produce sex-linked traits

Pages 18–21 and 186

Experiment 1.8: Colour-blindness inheritance

Discussion

1 How many girls and boys did Li and Maria have?

Students’ results will vary according to the counter toss.

2 How many children were colour blind? How many had normal vision?

Students’ results will vary according to the counter toss.

3 Was colour blindness more common in boys or girls?

Boys

4 Can non-colour-blind parents have a colour-blind son? Use a Punnet square to support your answer.

Yes

|  |  |  |
| --- | --- | --- |
|  | XB | Y |
| Xb | XB Xb | Xb Y |
| XB | XB XB | XB Y |

5 Can a non-colour-blind daughter have a colour-blind father? Use a Punnet square to support your answer.

Yes

|  |  |  |
| --- | --- | --- |
|  | Xb | Y |
| Xb | Xb Xb | Xb Y |
| XB | XB Xb | XB Y |

6 Can two colour-blind parents have a non-colour-blind son? Use a Punnet square to support your answer.

No

|  |  |  |
| --- | --- | --- |
|  | Xb | Y |
| Xb | Xb Xb | Xb Y |
| Xb | Xb Xb | Xb Y |

Conclusion

How is colour blindness inherited?

The allele for the recessive trait of colour-blindness is found on the X chromosome. Males only have one  
X chromosomes and therefore the recessive trait is more likely to appear in the phenotype. Females have two X chromosomes and therefore need to inherit two copies of the allele for the trait to appear in the phenotype.

Experiment worksheet answers

1.10 Mutations are changes in the DNA sequence

Pages 26–29 and 187

Skills lab 1.10: Identifying mutations

1 A normal RNA sequence is shown below, together with two different genetic mutations.

• Normal AUG ACG CAG AAU UGG GAU CCU ACG

• Mutation 1 AUG ACA CAG AAU UGG GAU CCU ACG

• Mutation 2 AUG AGC AGA AUU GGG AUC CUA CG

a Name the type of mutation represented in each case. Explain your answer.

Mutation 1: Point substitution: The sixth nucleotide G is replaced with an A.

b Describe the outcome of mutation 1 on protein synthesis. You may wish to consult the genetic code in Figure 8.7.

Mutation 2: Frameshift deletion: The sixth nucleotide G is removed.

c Describe the outcome of mutation 2 on protein synthesis.

The deletion of the sixth nucleotide shifts all the amino acids after that point.

2 Genetic Creutzfeldt–Jacob disease (CJD) is caused by an abnormal protein called PrPc. This protein is formed because of a mutation in the PrPc gene on chromosome 20 and occurs in DNA base triplet 200 in the gene’s sequence.

|  |  |  |  |
| --- | --- | --- | --- |
| DNA base triplet number | 199 | 200 | 201 |
| Normal gene | TGG | CTC | CAA |
| Mutated gene | TGG | TTC | CAA |

a What type of mutation is this?

Point substitution

b Describe the amino acid change that would occur in the PrPc protein.

Amino acid Lys will be inserted instead of Glu.

c Distinguish between natural and induced mutation.

Mutations that occur spontaneously are called natural mutations. Mutations that occur as a result of exposure to chemicals or radiation are called induced mutations.

Experiment worksheet answers

1.13 Genetic engineering is used in medicine

Pages 34–35 and 188

Challenge 1.13: Edible genetic engineering

Discussion

1 What is a plasmid?

A small loop of DNA that acts as a vector to transfer a gene into a bacterial cell.

2 Why is insulin needed by some members of the community?

Persons with Type 1 diabetes cannot make insulin. This means they cannot control their blood sugars and this will affect their health.

3 Before genetic engineering was possible, pig insulin was often used. Why would genetically engineered human insulin be preferable? (Consider the way the immune system would respond to pig insulin.)

The immune system may attack the pig insulin and destroy it. Human insulin is less likely to be recognised by the immune system and therefore be more effective.