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Discusssion / Activity 1 Suggested Answers

Reproduction

1. Outline the advantages & disadvantages of sexual versus asexual reproduction

Asexual Adv. Simpler process, allows rapid repro. to take advantage of available food,etc.
Disadv. Less genetic variation may lead to being more vulnerable to extinction.

Sexual Adv. Greater genetic variation, less vulnerable to extinction.
Disadv. More complex: requires more energy, more complex structures, co-ordination, etc.

2. Explain how internal & external fertilisation may be considered as adaptations to habitat.

All life was originally aquatic. In water, gametes can easily swim to achieve fertilisation. Therefore, external fertilisation was adequate. On land, gametes cannot swim in air or on solid surfaces. Internal fertilisation evolved to allow terrestrial life to be truly free of the aquatic habitat.

3. Contrast some characteristics of modern wheat to those of its wild ancestral plant, to highlight the advantages of selective breeding.

Ancestral Wheat Few, small seed kernels. Seeds are shed when mature. Stem bends over easily. Shows many variations in disease resistance, growth rates, etc.

Modern Wheat Many, large kernels. Seeds do not drop. Stem stays upright for easy harvest. Uniform growth rate and high disease resistance.

All the characteristics of modern wheat increase yield and make harvesting easier.

4.

a) List some reasons why animal or plant cloning gives even greater advantages.

Cloning allows even more precise “targetting” of the most desirable characteristics for propagation. This leads to exact copying of desirable plants or animals for food production, saving rare species, commercial seed-production, etc.

b) What is the biological “downside” to these methods of genetic manipulation?

This reduces genetic variations and increases the risk of extinction if conditions change suddenly due to new diseases, climate change, etc.

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Discusssion / Activity 2 Suggested Answers

Cell Replication

1. Answer each part with “mitosis” or “meiosis” or “both”.
In which cell division:

a) are all the chromosomes duplicated before division starts? Both
b) do the chromosomes line up in homologous pairs? Meiosis
c) are there 2 identical daughter cells produced? Mitosis
d) does the “spindle” pull identical chromatids apart, at some stage? Meiosis
e) does the nuclear membrane dissolve and later re-form? Both
f) do chromosomes line up in a single line? Mitosis
g) are there 4 different daughter cells produced? Meiosis

2.
a) What is the basic “chemical unit” of a DNA molecule? Nucleotide
b) This “unit” has 3 parts. Name them.
Sugar, phosphate group, one of 4 nucleotide “bases”

3. Using the letters A, C, G and T list all the possible base-pair groupings in DNA.
A=T or G=C are the only possibilities.

4. Why is it essential (for DNA replication) that DNA molecules are double-stranded?
So that each strand can act as a “template” for building a new, complementary strand.
This produces a new copy of the entire DNA molecule.

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Discusssion / Activity 3 Suggested Answers

DNA & Polypeptide Synthesis

1.

a) What (physically) is a DNA “codon”? 3 consecutive nucleotide bases.

b) What does each codon specify? One amino acid in a polypeptide chain.

c) What does one “gene” specify? One polypeptide molecule.

2. Briefly state or outline what happens:

a) during the process called “DNA Transcription”.

An m-RNA molecule is made using the DNA gene strand as a template. This re-writes the same code sequence in RNA code... ie it is transcribed, but not yet translated.

b) during “Translation” of a single gene.

The m-RNA is used by the ribosomes to build a polypeptide molecule. t-RNA’s carry amino acids into position; ribosome enzymes join them in a chain.

c) in the conversion of a polypeptide into a functional protein.

The polypeptide chain must twist & fold into a precise 3D shape.

d) when a protein causes an actual phenotype, such as eye-colour.

The protein may become an enzyme which controls a chemical reaction. A sequence of reactions might produce a phenotype chemical, such as a pigment molecule.

3. During polypeptide synthesis, what is the role of:

a) ribosomes?

Ribosomes “roll along” the m-RNA molecule providing the enzymes required join together the amino acids to form a polypeptide.

b) t-RNA?

Each t-RNA carries a specific amino acid, according to the “anti-codon” of the t-RNA.

The anti-codon “locks onto” the corresponding m-RNA codon. This ensures that each amino acid is in the correct sequence position in the polypeptide.

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Discusssion / Activity 4 Suggested Answers

Mendelian Genetics

1. Explain each of the following terms:

a) Alleles

Alternative forms of the gene for a particular characteristic.

b) Dominant gene

The gene which is expressed when 2 alternate alleles are present.

c) Recessive gene

The gene which is NOT expressed when 2 alternate alleles are present.

d) Phenotype

The actual appearance (or chemical or physiological form, etc) produced by a gene.

e) Genotype

A description of the 2 genes present for a particular trait.

f) Homozygous

When the 2 genes present for a specific trait are identical.

g) Heterozygous

When the 2 genes present for a specific trait are different... eg a dominant gene + a recessive gene.

2. What ratio of offspring is likely to occur in each general case?

a) Parents: homozygous-dominant gene x homozygous recessive gene.

100% dominant gene phenotype.

b) Parents: both heterozygous.

3:1 ratio (75%:25%) of dominant phenotype to recessive phenotype.

c) Parents: heterozygous x homozygous recessive gene.

1:1 ratio (50%:50%) of dominant phenotype to recessive phenotype.

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Discusssion / Activity 5 Suggested Answers

Non-Mendelian Genetics

1. What is “sex-linked inheritance”?
Your answer must describe how it is different to “mendelian inheritance”.
An inheritance pattern in which a trait is NOT inherited in the same way by each sex because the alleles involved are carried on the X-chromosome, but do not occur on the y-chromosome. The normal mendelian ratios may occur in females, but not in males.

2. Give an example of a human trait controlled by “multiple alleles”.
Include an outline of possible genotypes & phenotypes.
Human blood types: 3 possible alleles (A,B,o) result in 6 possible genotypes (AA, Ao, BB, Bo, AB, oo) and 4 possible phentypes (types A, B, AB and O).

3. In a species of plant, the flowers can be red or white. However, if a red-flowering plant is crossed with a white-flowering plant, the seeds grow into plants which have pink flowers.
a) What type of inheritance is operating? Incomplete dominance
b) Can you have a “pure-breeding” pink-flower type in this species? Explain your answer by suggesting the outcome of self-pollinating a pink-flowering plant.
No. Self-pollination of a pink-flowering plant will result in 25% red, 50% pink and 25% white offspring.

4. Outline the ways in which sexual reproduction produces genetic variation in offspring.
1. Genes of 2 different individuals are combined... new combinations of genes result.
2. During meiosis a) independant segregation of homologous chromosomes results in many combinations of chromatids (in gametes) each with different gene combos.
b) during segregation the process of “crossing-over” increases the variety of combinations of genes even more.
Together these 3 processes result in a vast increase in genetic variations in offspring.

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Discusssion / Activity 6 Suggested Answers

Population Genetics

1. Explain why dominant genes do NOT automatically increase their gene frequency in a population over generations. Dominant genes may show a higher frequency of apparent phenotypes, but this does not mean that their genes are more common. The recessive genes for a trait "hide" among heterozygous individuals and may have a much higher frequency than is apparent in the phenotype ratio.

2.

a) Outline the basic concept of the Hardy-Weinberg Principle.

Gene frequencies will NOT change unless there is migration, or non-random mating, or natural selection is occurring... etc.

b) How can this principle be used to study micro-evolution of living populations?

If a change in gene freq. is measured in a population, but the effects of migration, non-random mating, etc., are accounted for, then it indicates that natural selection must be operating.

3.

a) What was the HGP? Human Genome Project: a scientific project which successfully determined the entire human genome between 1990-2003. Further studies are continuing.

b) List some potential benefits which may flow from the HGP.

Enormous advances in treating genetic diseases, cancer, etc. The same technology applied to plants & animals may have applications in agriculture, renewable fuels, better understanding of evolution.

a) What is a "SNiP"? Single-Nucleotide Polymorphism = a genetic variation of a single nucleotide base in an individual's DNA genome.

b) List some current and potential applications of the study of SNiP's.

Some diseases are caused by, or linked with, specific SNiP's. Genetic engineering of SNiP's may result in new treatments or even cures in future. Occurrence of "racial SNip's" allow peoples' ancestry to be traced (in general terms) and has given new evidence of past migration patterns and human evolution.