**Topic 3.5: Genetic Modification & Biotechnology**

**Essential Idea: Biologists have developed techniques for artificial manipulation of DNA, cells and organisms.**

**Statements & Objectives:**

**3.5.U1 Gel electrophoresis is used to separate proteins or fragments of DNA according to size.**

Match restriction enzyme names to the bacteria in which they are naturally found.

Describe the role of restriction enzymes in nature and in biotechnology applications.

**(Describe**: Give a detailed account)

Contrast sticky vs. blunt ends.

(**Contrast** Give an account of the differences between two (or more) items or situations, referring to both (all) of them throughout.)

Identify a restriction site as either leaving sticky or blunt ends.

(I**dentify** Provide an answer from a number of possibilities. Recognize and state briefly a distinguishing factor or feature.)

Demonstrate accurate use of a micro-pipette.

(**Demonstrate** Prove or make clear by reasoning or evidence, illustrating with examples or practical application.)

Determine the number and size of DNA fragments after being exposed to restriction enzymes (both linear and plasmid DNA).

(**Determine** Obtain the only possible answer)

Explain the function and purpose of DNA electrophoresis.

(**Explain**: Give a detailed account including reasons or causes)

Describe how and why DNA fragments separate during electrophoresis.

**(Describe**: Give a detailed account)

Outline the functions of the buffer, marker and loading dye in DNA electrophoresis.​

(**Outline** Give a brief account or summary.)

**3.5.U2 PCR can be used to amplify small amounts of DNA.**

State the function of the PCR.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

Describe the selectivity of the PCR.​

**(Describe**: Give a detailed account)

**3.5.U3 DNA profiling involves comparison of DNA.**

Outline the process of DNA profiling.​

(**Outline** Give a brief account or summary.)

**3.5.U4 Genetic modification is carried out by gene transfer between species.**

Outline how the universality of the genetic code allows for gene transfer between species.

(**Outline** Give a brief account or summary.)

**3.5.U5 Clones are groups of genetically identical organisms, derived from a single original parent cell.**

Contrast sexual and asexual reproduction.

(**Contrast** Give an account of the differences between two (or more) items or situations, referring to both (all) of them throughout.)

Define clone and cloning.

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

Describe different ways in which natural clones can arise.

**(Describe**: Give a detailed account)

**3.5.U6 Many plants species and some animal species have natural methods of cloning.**

Define clone.

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

Outline two examples of natural cloning in plants.

(**Outline** Give a brief account or summary.)

**3.5.U7 Animals can be cloned at the embryo stage by breaking up the embryo into more than one group of cells.**

Describe the process of reproductive cloning via embryo splitting.

**(Describe**: Give a detailed account)

Outline example of cloning animal embryos via natural and artificial embryo splitting.​​

(**Outline** Give a brief account or summary.)

**3.5.U8 Methods have been developed for cloning adult animals using differentiated cells.**

Describe the process of reproductive cloning via somatic cell nuclear transfer.

**(Describe**: Give a detailed account)

**3.5.A1 Use of DNA profiling in paternity and forensic investigations.**

List example sources of DNA that can be used in DNA profiling.​​

**(List**: Give a sequence of brief answers with no explanation.)

**3.5.A2 Gene transfer in bacteria using plasmids makes use of restriction endonucleases and DNA ligases.**

Describe a technique for genetic modification including plasmids, restriction enzymes, reverse transcriptase and ligase.

**(Describe**: Give a detailed account)

Outline why plasmids with genes coding for antibiotic resistance are chosen as vectors in gene transfer between species

(**Outline** Give a brief account or summary.)

**3.5.A3 Assessment of potential risks and benefits associated with genetic modification of crops.**

Outline potential environmental, health and agricultural benefits and risks

associated with genetic modification of crops.

(**Outline** Give a brief account or summary.)

Assess the risks and benefits of an example of a genetically modified crop (i.e. golden rice).

(**Analyze** Break down in order to bring out the essential elements or structure. To identify parts and relationships, and to interpret information to reach conclusions.)

**3.5.A4 Production of clones embryos produced by somatic-cell nuclear transfer.**

Outline the production of Dolly the sheep using somatic cell nuclear transfer.​​

(**Outline** Give a brief account or summary.)

**3.5.S1 Design of an experiment to assess one factor affecting the rooting of stem-cuttings.**

Outline preparation of a plant for rooting of a stem cutting.

(**Outline** Give a brief account or summary.)

List manipulated, responding and controlled variables in an experiment of rooting stem-cuttings.

**(List**: Give a sequence of brief answers with no explanation.)

**3.5.S2 Analysis of examples of DNA profiles.**

Analyze a DNA profile to determine relatedness or forensic guilt. ​

(**Analyze** Break down in order to bring out the essential elements or structure. To identify parts and relationships, and to interpret information to reach conclusions.)

**3.5.S3 Analysis of data on risks to monarch butterflies of Bt crops.**

Outline the formation and use of Bt crops in agriculture.

(**Outline** Give a brief account or summary.)

Assess the impact of Bt corn on monarch butterflies.

(**Analyze** Break down in order to bring out the essential elements or structure. To identify parts and relationships, and to interpret information to reach conclusions.)

**3.5.NOS Assessing risks associated with scientific research- scientists attempt to assess the risks associated with genetically modified crops or livestock.**

State two ways in which the risk of scientific research can be assessed.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

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**Key Terms**

Bioinformatics

Buffer

DNA

DNA profile

DNA sequencing

therapeutic cloning

endonucleases

differentiated cell

recombinant DNA

linear DNA

sexual

DNA stain

electrophoresis

enzymes

ethanol

extraction

forensics

sticky end

undifferentiated cell

transgenic

buffer

​asexual

genome

loading

dye

polymerase

plasmid

insulin

DNA ligase

Embryo

somatic cell

​loading dye

​stem cutting

microliter

palindrome

PCR

Pipette

Paternite

Cloning

Bioreactor

​Plasmid

plasmid DNA

blunt ends​

nuclear transfer

restriction enzyme

restriction site

electrophoresis

genetic modified crops

genetic modification

restriction enzyme

transgenic

gene transfer

​micro-pipette

​DNA fragments

reverse transcriptase