

Biotechnology and Its Applications — Assignment 2

Class 12 Biology · Higher-difficulty challenge set + integrated problems · Answer key included · Narayan Gurukul Academy

Instructions: (1) Attempt all questions; start with the topic-wise challenge set, then attempt the integrated (multi-topic) problems.
(2) Give all answers with correct SI units. $g = 10 \text{ m/s}^2$ unless stated.
(3) A final answer key is provided at the end — try the full set before checking it.

Part A — Topic-wise challenge questions

Scope of Biotechnology Applications

1. What is the scope of biotechnology in agriculture?
2. What is a genetically modified crop?
3. Explain the benefits of GM crops.

Agricultural Applications — Bt Crops

1. Name the bacterium used to make Bt cotton.
2. How does Bt toxin kill insects?
3. Describe the production of Bt cotton and its action.

GM Crops and RNAi-Mediated Pest Resistance

1. What is RNA interference?
2. How does RNAi confer pest resistance?
3. Describe RNAi-mediated pest resistance.

Medical Applications — Recombinant Human Insulin

1. Which microbe produces recombinant human insulin?
2. How is human insulin produced by genetic engineering?
3. Why is recombinant insulin better than animal insulin?

Gene Therapy

1. What is gene therapy?
2. How is gene therapy used to treat ADA deficiency?
3. Explain gene therapy with an example.

Molecular Diagnostics and Transgenic Animals

1. What is PCR?
2. How is PCR used in diagnosis?
3. Explain the use of transgenic animals.

Ethical Issues and Bioethics

1. What is biopiracy?
2. What are the ethical issues raised by genetic engineering?
3. Discuss the ethical issues raised by genetic engineering.

Part B — Integrated problems (multi-topic)

1. Describe the agricultural applications of biotechnology.
2. Describe the medical applications of biotechnology.
3. Explain the production of human insulin and gene therapy.
4. Describe RNAi-mediated pest resistance.
5. Describe the techniques of molecular diagnosis.
6. Discuss the ethical issues raised by genetic engineering and biopiracy.

Answer Key

Scope of Biotechnology Applications

Improves crops (yield, resistance, nutrition), produces medicines and diagnostics; e.g. GM crops such as golden rice.

Agricultural Applications — Bt Crops

Bacillus thuringiensis gene in cotton; the protoxin becomes active in the alkaline insect gut, forms pores and kills the pest; harmless to humans.

GM Crops and RNAi-Mediated Pest Resistance

RNAi silences the target mRNA; used to develop resistance against the nematode *Meloidogyne incognita* in tobacco.

Medical Applications — Recombinant Human Insulin

The human insulin gene is inserted into *E. coli*, which produces insulin; used to treat diabetes.

Gene Therapy

A normal gene is introduced by a vector to correct a defect; e.g. ADA deficiency, where the adenosine deaminase gene is supplied.

Molecular Diagnostics and Transgenic Animals

PCR amplifies DNA; ELISA detects antigens/antibodies; transgenic animals carry a foreign gene (e.g. transgenic mice).

Ethical Issues and Bioethics

Patenting of life forms, biosafety, misuse of genetic data and biopiracy (unauthorised use of biological resources or traditional knowledge).

Integrated problems

1: GM crops, Bt crops, RNAi. 2: Recombinant insulin, gene therapy, diagnostics. 3: Insulin gene → *E. coli*; ADA gene → patient cells. 4: dsRNA silences nematode mRNA. 5: PCR and ELISA. 6: Bioethics; biopiracy examples.