Genetics in the Cosmic Context

Genetics · Answer Key · 20 Questions

1. During the 2016 NASA Twins Study, which specific type of DNA modification was measured in Scott Kelly to determine the effects of long-duration spaceflight on the human epigenome?

A) Histone acetylation
B) DNA methylation
C) ATP-binding
D) Protein phosphorylation

2. In the 'Bion-M1' mission, which organism was primarily used to study the genetic expression changes caused by cosmic radiation and microgravity over 30 days in orbit?

A) Mus musculus (House mouse)
B) Drosophila melanogaster
C) Caenorhabditis elegans
D) Arabidopsis thaliana

3. What is the primary genetic phenomenon observed in the plant 'Arabidopsis thaliana' when grown aboard the International Space Station compared to terrestrial controls?

A) Complete silence of all metabolic genes
B) Significant downregulation of cell wall-related genes
C) Hyper-mutation of nuclear DNA
D) Permanent loss of chlorophyll production

4. Research on the International Space Station regarding 'T-cell' genetic expression revealed that microgravity suppresses the activation of which specific transcription factor?

A) NF-kappaB
B) HIF-1alpha
C) FOXP3
D) MYC

5. The experiment 'Micro-11' on the ISS studied the genetic and physiological factors of which human process in microgravity?

A) Neurogenesis
B) Sperm motility and fertilization
C) Cardiac muscle regeneration
D) Synaptic pruning

6. Which genetic sequencing tool was the first to successfully identify unknown microbes on the ISS without returning samples to Earth?

A) Ion Torrent PGM
B) MinION Nanopore Sequencer
C) PacBio Sequel
D) Illumina HiSeq

7. What genetic effect has been observed in 'Caenorhabditis elegans' (nematodes) subjected to prolonged spaceflight?

A) Increased longevity via DAF-16 pathway
B) Complete suppression of reproduction
C) Instant apoptosis of neurons
D) Inversion of chromosomes 1 and 2

8. In studies of 'space-exposed' bacteria like Bacillus subtilis, which genetic mechanism is frequently upregulated to survive the vacuum of space?

A) Enhanced DNA repair systems
B) Production of cellulose fibers
C) Rapid mitochondrial division
D) Increased viral lysis

9. NASA's 'Rodent Research' missions have documented that spaceflight induces a significant shift in the expression of genes related to which biological system?

A) Circadian rhythm and bone density
B) The production of bile
C) The maturation of hair follicles
D) The synthesis of Vitamin K

10. What specific genetic observation in the 'Twins Study' regarding telomere length was unexpected upon Scott Kelly's return to Earth?

A) They completely disappeared
B) They significantly lengthened
C) They remained constant
D) They fragmented into RNA

11. The 'GeneLab' database aggregates omics data from space experiments; which 'omics' field focuses on the study of the entire set of proteins expressed by a genome in space?

A) Transcriptomics
B) Proteomics
C) Metabolomics
D) Epigenomics

12. In experiments involving 'Drosophila' in orbit, which genetic pathway was identified as being altered, affecting the fly's immune response?

A) IMD pathway
B) Wnt signaling
C) Notch pathway
D) Hedgehog pathway

13. What is the primary concern for genetic stability in humans exposed to high-LET (Linear Energy Transfer) cosmic radiation in deep space?

A) Increased frequency of double-strand DNA breaks
B) Accelerated production of ribosomes
C) Inhibition of histone methylation
D) Immediate degradation of mRNA

14. Studies on the ISS regarding 'yeast' (Saccharomyces cerevisiae) genetics in microgravity focused on which cellular function?

A) Mitochondrial inheritance
B) DNA segregation during mitosis
C) Protein folding in the endoplasmic reticulum
D) Oxidative stress response

15. Which genetic molecule is used as a biomarker for cellular stress in astronauts measured via the 'Biomolecule Sequencer' on the ISS?

A) mRNA
B) rRNA
C) tRNA
D) siRNA

16. The experiment 'Plant Gravity Sensing' (PGS) on the ISS explored the genetic basis of which tropism?

A) Phototropism
B) Chemotropism
C) Gravitropism
D) Thigmotropism

17. What was the result of the 'Mouse Epigenetics' study concerning the sperm of mice exposed to spaceflight?

A) Full sterility observed
B) Altered gene expression profiles in offspring
C) Increased birth weight
D) Total loss of XY chromosomes

18. In the study of 'E. coli' in microgravity, which genetic response was observed to increase its antibiotic resistance?

A) Increased expression of multidrug efflux pumps
B) Deletion of the ribosomal RNA genes
C) Enhanced conjugation rate
D) Decreased metabolic rate

19. Which genetic technique is most commonly used in space biology to analyze differential gene expression in limited samples?

A) RNA-Seq
B) Sanger Sequencing
C) Southern Blotting
D) Karyotyping

20. The 'NASA Twins Study' showed that spaceflight led to the 'un-silencing' of which type of genetic elements, potentially causing genomic instability?

A) Transposable elements (LINE-1)
B) Introns
C) Pseudogenes
D) Centromeric repeats