Nanotechnology in Nature and Environment

Nanotechnology · Answer Key · 12 Questions

1. The iridescent colors of butterfly wings, often cited as inspiration for nanostructured materials, are primarily caused by:

A) Pigmentation within the wing scales
B) The scattering of light by nanoscale structures on the scales
C) Fluorescence emitted by the wing scales
D) The absorption of specific wavelengths of light by the scales

2. Lotus leaves exhibit superhydrophobicity (extreme water repellency) due to nanoscale and microscale structures that minimize contact with water. This phenomenon is known as:

A) Capillary action
B) Adhesion
C) The Leidenfrost effect
D) The Lotus effect

3. Certain species of gecko can climb vertical surfaces due to adhesive structures on their toes. These structures are comprised of millions of microscopic hairs called setae, which further split into even smaller nanoscale hairs known as:

A) Villins
B) Fibrils
C) Spatulae
D) Cilia

4. Nanomaterials are being explored for environmental remediation. Which of these is a primary application of nanoscale zero-valent iron (nZVI) particles in this field?

A) Removing dissolved oxygen from water
B) Degrading chlorinated organic pollutants in groundwater
C) Increasing the salinity of soil
D) Promoting the growth of algae blooms

5. The self-cleaning properties of some bird feathers are partly attributed to nanoscale surface textures that repel water and dirt. This biomimetic principle is also applied in the development of:

A) Biodegradable plastics
B) Nanocoatings for paints and textiles
C) Artificial sweeteners
D) Energy-efficient light bulbs

6. Spider silk is renowned for its exceptional strength-to-weight ratio. While macro-level properties are well-known, the arrangement of protein molecules at the nanoscale contributes significantly to its unique mechanical characteristics, inspiring the creation of:

A) Lightweight construction materials
B) High-performance adhesives
C) Advanced optical fibers
D) Biodegradable packaging

7. Photosynthesis, the process by which plants convert light energy into chemical energy, involves complex molecular machinery. Research into artificial photosynthesis aims to replicate this using nanostructures to enhance:

A) Water purification efficiency
B) Solar energy conversion and storage
C) Nutrient absorption from soil
D) Carbon dioxide sequestration

8. Nanoparticles are being investigated for their potential to enhance agricultural productivity. One application involves using nanoscale fertilizers to:

A) Increase soil acidity
B) Improve nutrient uptake by plants and reduce leaching
C) Attract pest insects
D) Accelerate soil erosion

9. The structural coloration seen in some seashells and minerals, similar to butterfly wings, is a result of light interacting with ordered nanoscale structures, leading to:

A) Chemical reactions within the material
B) The absorption of light by pigments
C) Diffraction and interference of light waves
D) Thermal emission

10. Biofouling, the accumulation of microorganisms, plants, algae, and other organisms on surfaces submerged in water, can be combatted using nanotechnological approaches. One such approach involves developing coatings with nanoscale features that:

A) Promote cell adhesion
B) Resemble shark skin to reduce drag and prevent settlement
C) Increase friction
D) Emit chemical signals that attract organisms

11. The deep blue color of the Morpho butterfly is a classic example of structural color. This phenomenon is achieved through multilayered nanostructures on the wing scales that interfere with specific wavelengths of light, causing:

A) Absorption of all wavelengths
B) Refraction of all wavelengths
C) Scattering and constructive interference of blue light
D) Fluorescence of yellow light

12. In the field of environmental monitoring, nanoscale sensors are being developed for detecting pollutants. These sensors often rely on the unique electrical or optical properties of nanomaterials that change when exposed to specific chemical compounds, allowing for:

A) The synthesis of new pollutants
B) The amplification of environmental signals
C) The selective detection of target substances
D) The neutralization of all airborne particles