

Biomimetic Robotics and Environmental Engineering

Robotics · Answer Key · 15 Questions

1. Which specific biological mechanism is mimicked by the Harvard Ambulatory Micro-Robot (HAMR) to achieve its high-speed locomotion?

- A) The undulating motion of a leech
- B) The rapid contraction of insect thoracic muscles**
- C) The hydrostatic pressure system of an earthworm
- D) The asymmetrical gait of a crab

2. In the development of the 'RoboBee', what challenge does the flapping frequency of real bees pose for current micro-actuator technology?

- A) The need for non-resonant piezoelectric drive cycles
- B) Maintaining a frequency of 120Hz at low voltages
- C) The requirement for passive wing-hinge fatigue resistance**
- D) The difficulty of atmospheric air-density modulation

3. The 'AquaJelly' autonomous underwater robot mimics the movement of a jellyfish to achieve high energy efficiency. What is the primary physical principle it utilizes?

- A) Active vortex generation through bell contraction**
- B) Electro-osmotic propulsion in saline environments
- C) Variable buoyancy control via internal ballast
- D) Magnetic resonance damping of the umbrella

4. What is the primary function of the 'CuraBot' in environmental monitoring, specifically regarding pollination?

- A) Replacing wild bees in greenhouse environments
- B) Mapping nectar density using infrared sensors
- C) Collecting pollen via electrostatic adhesion**
- D) Identifying invasive plant species via LIDAR

5. The 'GhostSwimmer' robot, developed for maritime environmental sensing, mimics the morphology of which marine animal to reduce acoustic signatures?

- A) Bluefin Tuna**
- B) Common Bottlenose Dolphin
- C) Great White Shark
- D) Green Sea Turtle

6. To mimic the gecko's adhesive capability in climbing robots, researchers utilize van der Waals forces. Which material is typically used to recreate the setae structure?

- A) Carbon Nanotubes
- B) Polydimethylsiloxane (PDMS)**
- C) Graphene Oxide
- D) Titanium Dioxide

7. The 'SnakeBot' designed for search and rescue in mountainous terrain utilizes which unique form of locomotion observed in the Crotalus cerastes?

- A) Concertina motion
- B) Sidewinding**
- C) Lateral undulation
- D) Rectilinear locomotion

8. What specific aspect of the 'VelociRoACH' robot allows it to maintain stability while traversing uneven natural terrain at high speeds?

- A) Active gyroscopic stabilization
- B) Passive mechanical compliance**
- C) Variable center of gravity shifting
- D) Feedback-controlled tail articulation

9. In environmental robotics, the 'Robot Fish' (GPL) is used to detect water pollution. What is the main sensory input used for real-time navigation?

- A) Chemical-plume tracing via fluorescence sensors
- B) Bio-inspired lateral line pressure sensors**
- C) Thermal gradient mapping
- D) Acoustic echolocation

10. The 'StickyBot' employs a hierarchical structure inspired by nature to mimic what specific biological capability?

- A) Bioluminescence for deep-sea communication
- B) Surface-tension adhesion**
- C) Regeneration of damaged limbs
- D) Phototaxis for energy harvesting

11. What physiological structure does the 'Octobot' mimic to achieve its flexible, soft-robotic movement?

- A) The hydrostatic skeleton of an octopus**
- B) The rigid chitinous exoskeleton of a crustacean
- C) The radula of a mollusk
- D) The siphon of a cephalopod

12. The 'Valkyrie' robotic platform is often used to test bipedal stability. Which aspect of avian biology is most relevant to its landing mechanics?

- A) The locking mechanism in the tarsometatarsus**
- B) The rapid flapping of the rectrices
- C) The air-cushioning effect of downy feathers
- D) The shifting of the center of mass in the cervical vertebrae

13. Why are soft robots, such as those inspired by earthworms, superior for soil sampling in sensitive environmental areas?

- A) They produce higher torque than rigid robots
- B) They exert lower ground pressure and minimize substrate disruption**
- C) They can process chemical samples internally via peristalsis
- D) They rely on geothermal energy for propulsion

14. Which principle of plant physiology is utilized in 'Root-Bots' to navigate underground environments?

- A) Phototropism-driven navigation
- B) Thigmotropism-inspired obstacle avoidance**
- C) Gravitropism sensing for structural stability
- D) Circumnutation for soil porosity detection

15. The 'Pneufish' uses soft pneumatic actuators. Which biological movement pattern does it prioritize for minimizing drag in water?

- A) Carangiform swimming**
- B) Anguilliform locomotion
- C) Thunniform oscillation
- D) Ostraciiform propulsion