

1 The biodiversity of species in Costa Rica is one of the highest in the world.

Costa Rica represents 0.3% of the Earth's total land area. It has 4% of all identified species of living organisms. Many of these species live in the rainforests of this country.

(a) (i) Explain what is meant by the term **biodiversity**.

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(ii) Describe how the species richness of the rainforests in Costa Rica could be measured.

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(b) A study was carried out to investigate the antimicrobial properties of plants found in Costa Rica. The species tested are all used in traditional medicine.

Nine of the species tested showed antimicrobial properties and six of these species are found only in the rainforest.

(i) Suggest why the results of this investigation support the need to maintain biodiversity.

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\*(ii) The species tested included the Jatobá plant, *Hymenaea courbaril*.

The photograph shows leaves, flowers and seed pods of the Jatobá plant.



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Magnification  $\times 0.3$

Describe how the antimicrobial properties of the seeds of the Jatobá plant could be tested.

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(iii) Some of the plants tested could be used to develop new drugs to treat diseases caused by bacteria.

Before these drugs could be approved for use, they would have to be tested on animals and healthy volunteers.

Suggest why these drugs would have to be tested on animals and healthy volunteers.

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**(Total for Question 1 = 12 marks)**

2 The scientific article you have studied is adapted from articles in *Nature* and *Scientific American*.

Use the information from the article and your own knowledge to answer the following questions.

(a) Rabies is a 'nasty infection' caused by a virus (paragraph 5).

Explain how scientists would be able to determine that the rabies pathogen is a virus.

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\*(b) Suggest how researchers had genetically modified the pathogen to 'provoke an effective immune response' (paragraph 12).

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(c) Octopamine is a neurotransmitter (paragraph 24). Libersat and his team believe that wasp venom probably blocks octopamine receptors in the central nervous system of the cockroach.

Suggest **two** ways that the 'compound that reactivates octopamine receptors' (paragraph 25) could work.

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(d) Suggest how scientists, such as Hughes, could have estimated that ants comprise 'half of all insect biomass worldwide' (paragraph 31).

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(e) 'While the manipulated individual may look like an ant, it represents a fungal genome expressing fungal behaviour through the body of an ant' (paragraph 33).

Suggest how fungal genes may be expressed and affect the behaviour of these ants.

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Ruled lines for student response.

(f) Suggest what is meant by the term **clock genes** (paragraph 35).

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(g) Suggest how a lack of 'signals' (paragraph 36) could lead to muscle atrophy.

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(h) 'Instead of one variable species' (paragraph 44), Evans, Hughes and Elliot have identified four new species of the fungus.

Suggest how these could have been identified as separate species.

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(i) There is evidence showing that ants parasitised by the fungus bite the main veins of leaves (paragraphs 35 and 47).

Suggest the advantages to the zombie fungus of this ant behaviour.

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**(Total for Question 2 = 30 marks)**