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Activity

Better together: insect–plant mutualism

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Introduction

Use information from Steph Dolben's article, *Better together: insect–plant mutualism*, and your own knowledge to answer the following questions.

Question 4 tests recall with understanding (assessment objective 1) of a topic that might **not** be included in the biology specification you are following.

Questions

1 Compare and contrast the terms 'mutualism' and 'commensalism'. [2 marks]

2 The article gives examples of symbiotic relationships involving organisms from two biological kingdoms, Animalia and Plantae.

Name **two** other biological kingdoms and, for each, give **one** example of a symbiotic relationship that includes an organism from that kingdom. [3 marks]

3 The article tells us that 'clownfish have a mucus coating on their skin, protecting them from the anemone's sting'.

A team of scientists investigated the nature of this mucus coating in one species of clownfish, *Amphiprion percula*. This clownfish usually forms a mutualistic relationship with the sea anemone, *Heteractis magnifica*. The scientists bought captive-bred clownfish from a tropical fish supplier. The fish were termed 'naïve', meaning they had no previous contact with *H. magnifica*.

They kept one group of clownfish (the experimental clownfish) and some sea anemones in separate tanks of seawater. Although the clownfish and anemones never came into direct contact, the seawater circulated between their tanks. They kept a second group of clownfish as controls.

At regular intervals, the scientists investigated the bacterial populations living in the surface mucus – the epithelial microbiota – of the clownfish and the sea anemones.

a Suggest why it was important that the clownfish had no previous contact with *H. magnifica*. [1 mark]

b Suggest the conditions in which the scientists would keep the control group of clownfish. [2 marks]

At the end of the experiment, the scientists found that:

- the epithelial microbiota of the control group of clownfish had not changed
- the epithelial microbiota of the experimental clownfish had changed and become similar to that of the sea anemones.

c Suggest two possible explanations for these results. [2 marks]

d What can you conclude about the mutualistic relationship between *A. percale* and *H. magnifica*? Include discharge of the anemone's nematocysts in your answer. [5 marks]

e Does this investigation suggest that this relationship between the clownfish and the sea anemones is an example of obligate mutualism? Explain your answer. [1 mark]

4 The article says, 'pollination involves the transferral of male gametes, inside the pollen grains, from the male part of the plant (anther) to the female part (stigma) to facilitate fertilisation and the development of seeds'.

Describe the processes following pollination that end in fertilisation. [6 marks]

5 Fig trees are described as an example of a keystone species.

Explain why. [2 marks]

Model answers

1 Both involve an ecological relationship between organisms of two different species.

In mutualism both benefit, but in commensalism the host neither benefits nor is harmed.

2 Fungi and Prokaryotae

One example involving fungi

One example involving prokaryotes

3 **a** Their epithelial microbiota would be natural / the epithelial microbiota would be the same in all the clownfish.

b The same conditions / temperature / pH / oxygen concentration / feeding programme as the experimental fish.

But seawater is not circulated with that of sea anemones.

c The seawater transferred bacteria from the epithelium of sea anemones, which colonised the skin of the experimental clownfish.

The seawater transferred chemicals/hormones from the sea anemones that changed clownfish physiology/behaviour.

d It is not intrinsic / it takes time to develop.

The nematocysts are triggered by epithelial microbiota that is different from that of the sea anemones.

The natural epithelial microbiota of 'naïve' clownfish are different from that of sea anemones.

So naïve clownfish are killed (by discharged nematocysts).

Change in epithelial microbiota of clownfish exposed to water inhabited by sea anemones results in nematocysts not being stimulated.

e No, because in the laboratory, the naïve clownfish survived without the sea anemones.

4 Pollen grain absorbs water (from stigma) and splits.

Pollen tube nucleus controls growth of pollen tube (down the style).

Generative cell divides by mitosis to form two (haploid) male gametes.

Pollen tube enters embryo sac via micropyle and its tip degenerates.

One male gamete fuses with the female gamete to form a (diploid) zygote.

One male gamete fuses with the two polar nuclei to form a (triploid primary) endosperm cell.

5 They provide abundant food all year round.

If they were lost, thousands of other species would be lost / many food chains would be broken.