Day 24

READING PASSAGE 3

*You should spend about 20 minutes on **Questions 1–13**, which are based on Reading Passage 3 below.*

Swarm theory

I used to think that ants knew what they were doing. The ones marching across my kitchen bench looked so confident that I figured they had a plan, knew where going and what needed to be done. How else could ants organise highways, build elaborate nests, stage epic raids and do all of the other things ants do? But it turns out I was wrong. Ants aren't clever little engineers, architects or warriors after all – at least not as individuals. When it comes to deciding what to do next, most ants don't have a clue. 'If you watch an ant trying to accomplish something, you'll be impressed by how inept it is,' says Deborah M Gordon, a biologist at Stanford University. How do we explain, then, the success of Earth's 12,000 or so known ant species? They must have learned something in 140 million years.

'Ants aren't smart,' Gordon says. 'Ant colonies are.' A colony can solve problems unthinkable to individual ants, such as finding the shortest path to the best food source, allocating workers to different tasks, defending territory from neighbours. As individuals, ants might be tiny dummies, but as colonies they respond quickly and effectively to their environment. They do this with something called swarm intelligence. Where this intelligence comes from raises a fundamental question in nature: how do the simple actions of individuals add up to the complex behaviour of a group? How do hundreds of honeybees make a critical decision about their hive if many of them disagree? What enables a school of herring to coordinate its movements so precisely it can change direction in a flash, like a single organism? One key to an ant colony is that no one's in charge. No generals command ant warriors. No managers boss ant workers. The queen plays no role except to lay eggs. Even with half a million ants, a colony functions just fine with no management at all – at least none that we would recognise. It relies instead upon countless interactions between individual ants, each of which is following simple rules of thumb. Scientists describe such a system as 'self-organising'.

Consider the problem of job allocation. In the Arizona desert, where Deborah Gordon studies red harvester ants, a colony calculates each morning how many workers to send out foraging for food. The number can change, depending on conditions. Have foragers recently discovered a bonanza of tasty seeds? More ants may be needed to haul the bounty home. Was the nest damaged by a storm last night? Additional maintenance workers may be held back to make repairs. An ant might be a nest worker one day, a trash collector the next. But how does a colony make such adjustments if no one's in charge? Gordon has a theory.

Ants communicate by touch and smell. When one ant bumps into another, it sniffs with its antennae to find out if the other belongs to the same nest and where it has been working. (Ants that work outside the nest smell different to those that stay inside.) Before they leave the nest each day, foragers normally wait for early morning patrollers to return. As patrollers enter the nest, they touch antennae briefly with foragers. 'When a forager has contact with a patroller, it's a stimulus for the forager to go out,' Gordon says. 'But the forager needs several contacts more than ten seconds apart before it will go out.' To see how this works, Gordon and her team captured patroller ants as they left a nest one morning. After waiting half an hour, they simulated the ants' return by dropping glass beads into the nest entrance at regular intervals – some coated with patroller scent, some with maintenance worker scent, some with no scent. Only the beads coated with patroller scent stimulated foragers to leave the nest. Their conclusion: foragers use the rate of their encounters with patrollers to tell if it's safe to go out. (If you bump into patrollers at the right rate, it's time to go foraging. If not, it's better to wait. It might be too windy, or there might be a hungry lizard out there.) Once the ants start foraging and bringing back food, other ants join the effort, depending on the rate at which they encounter returning foragers. 'So nobody's deciding whether it's a good day to forage. The collective is, but no particular ant is.' That's how swarm intelligence works: simple creatures following simple rules, each one acting on local information.

When it comes to swarm intelligence, ants aren't the only insects with something useful to teach us. Thomas Seeley, a biologist at Cornell University, has been looking into the uncanny ability of honeybees to make good decisions. With as many as 50,000 workers in a single hive, honeybees have evolved ways to work through individual difference of opinion to do what's best for the colony. Seeley and others have been studying colonies of honeybees to see how they choose a new home. To find out, Seeley's team applied paint dots and tiny plastic tags to all 4,000 bees in each of several swarms that they ferried to Appledore Island. There, they released each swarm to locate nest boxes they had placed on one side of the island. In one test, they put out five nest boxes. Scout bees soon appeared at all five boxes. When they returned to the swarm, each performed a dance urging other scouts to go and have a look. These dances include a code to give directions to a box's location. The strength of each dance reflected the scout's enthusiasm for the site. After a while, a small cloud of bees was buzzing around each box. As soon as the number of scouts visible near the entrance to a box reached about 15, the bees at that box sensed that a decision had been reached and returned to the swarm with the news. The bees' rules for decision-making – seek a diversity of opinions, encourage a free competition among ideas, and use effective mechanisms to narrow choices – so impressed Seeley that he now uses them at Cornell in his role as chairman of his department.

Questions 1–5

*Choose the correct letter **A**, **B**, **C** or **D**.*

Write the correct letter in boxes 1–5 on your answer sheet.

1 In the first paragraph, what does the writer conclude about ants?

A They are invasive pests in the home.
B They can achieve great things working alone.
C They form social groups that are similar to human ones.
D They are less impressive as individuals than she thought.

2 According to the second paragraph, what is the 'fundamental question' in nature?

A How do large groups of animals appoint a leader?
B How do large groups of animals reach an agreement?
C Do different species of animals use similar behaviour?
D Why are small insects better organised than larger mammals?

3 What is the focus of Deborah Gordon's research?

A The effects of bad weather on ant colonies.
B The number of ants required to maintain the nest.
C The methods ants use to assign different jobs.
D The role of the queen ant in organising the colony.

4 In the fourth paragraph, what are we told about forager and patroller ants?

A A colony needs more forager ants than patroller ants.
B Patrollers' movements determine what foragers will do.
C Patrollers are the first ants to bring food back to the nest.
D Foragers spend more time out of the nest than patroller ants.

5 In an experiment, Deborah Gordon's team

A mimicked patroller ants returning to the nest.
B left a trail of food for patroller ants to follow.
C followed patroller ants to see where they went to.
D changed the scent of patroller ants to that of forager ants.

Questions 6–9

Complete the following sentences using ***NO MORE THAN TWO WORDS AND/OR A NUMBER*** *from the passage.*

Write your answers in boxes 6–9 on your answer sheet.

6 Approximately …………… different types of ant have been identified.

7 Ants use their …………… to identify another ant.

8 A …………… is one animal that preys on ants.

9 Ant colonies use …………… to reach a decision.

Questions 10–13

Complete the summary using the list of words, ***A–G****, below.*

Write the correct letter, ***A–G****, in boxes 10–13 on your answer sheet.*

Appledore Island honeybee study

First, the scientists **10** …………… each of the bees involved in their experiment. Next the bees were **11** …………… . The scientists placed several nest boxes in an area away from the bees. Scout bees inspected the nest boxes and **12** …………… to other bees where the boxes were. They chose their nest box once enough bees had **13** …………… there.

A attracted	**B** found	**C** gathered	**D** located
E signalled	**F** marked	**G** relocated	