



PART 2

Read the text below and answer questions 14–26.

Insect Signalling and Sensory Hierarchies

Insects, the extraordinarily diverse arthropod group that includes ants, bees, termites and crickets, inhabit sensory worlds that differ sharply from the one humans take for granted. A communication channel that seems central to mammals may be peripheral or even functionally irrelevant for an insect living in dense vegetation, narrow burrows, or lightless nest chambers. For this reason, insect signalling cannot be described as a single “best” system. Instead, it is better understood as a hierarchy of modalities—chemical, tactile, visual, acoustic and vibrational—shaped by ecological constraints, energetic budgets, and the physical properties of the habitat through which information must travel.

Airborne sound, for instance, is highly salient to humans, yet it plays a surprisingly restricted role for many insect lineages. In cluttered vegetation and underground environments, sound transmission can be unreliable, easily masked by background noise, and disproportionately expensive to produce at meaningful ranges. By contrast, chemical information is often amplified to an extraordinary degree. Olfactory signalling, mediated by pheromones and cuticular compounds, can provide durable, spatially distributed messages that persist where light is absent and where acoustic cues fail. Across many taxa, chemical cues allow individuals to recognise conspecifics, coordinate collective movement, regulate reproduction, and trigger context-specific behaviours in nestmates.

However, the chemical channel is not uniform across insects; it varies with life history and behavioural demand. Termites that spend almost their entire lives within soil or wood appear especially dependent on odour trails and colony-specific blends. Their olfactory neural tissue is conspicuous, and behavioural work repeatedly demonstrates precise trail fidelity even when visual cues are eliminated. Yet in some visually oriented hunters—such as certain wasps foraging in open daylight—chemical cues may still be present while being less dominant. Where rapid interception is required, an overcommitment to slow-diffusing odours could be maladaptive, because odour plumes take time to form and can be distorted by wind. In such contexts, selection may favour faster channels that support quick pursuit and immediate targeting.

Contact chemoreception, or taste in the strict sense, also illustrates how sensory capacity can be unevenly expressed. Many insects possess gustatory sensilla, but these do not always support discriminations as fine-grained as those of vertebrates. In some ants that feed on a narrow range of plant exudates, receptors on the mouthparts are sparse and the corresponding pathways appear rudimentary. The result is not total absence of taste, but a



limited capacity to reject marginally unsuitable food once ingestion has begun. In practical terms, “evaluation” may occur late in the sequence—after contact and partial consumption—rather than through the rapid pre-ingestion screening typical of animals with more elaborate gustatory systems.

Mechanoreception, often overlooked by human observers, may be among the most versatile channels in insect societies. Touch is sometimes dismissed as secondary because it lacks the conspicuous drama of colour patterns or loud calls, yet this inference is weak. In crowded colonies, antennal contact can function as rapid information exchange, while bodily pushing and brief tapping can redirect nestmates without any chemical deposition. Tactile cues also operate in courtship, where sequences of antennal stroking followed by precisely timed leg contact can precede mating and appear to reduce aggressive rejection at the final moment of approach. The anatomical sensitivity of the region around the antenna bases further underlines the channel’s significance: individuals often withdraw sharply when that area is contacted unexpectedly.

Vibration extends mechanoreception beyond direct contact. Many insects detect substrate-borne signals through the legs, allowing information to pass along plant stems or through nest material without being broadcast to distant predators. In leafcutter ants, for example, vibrational cues can modulate cutting behaviour on leaves and may help regulate traffic on narrow trails where congestion is costly. Such signals are short-range by mammalian standards, but in the dense micro-environments insects inhabit, short-range may be precisely what is required: highly local messages can coordinate activity without drawing attention across wider space.

Visual capacity also varies greatly and is strongly linked to habitat. Subterranean termites, for instance, possess eyes that are extremely reduced or absent; the light they register may be limited to coarse changes in brightness, sufficient mainly for avoiding exposure at openings. Paper wasps, by contrast, have been observed in field conditions to pursue moving objects with visually guided precision, even if the lateral placement of their eyes implies limited depth perception in the manner of front-eyed predators. Honeybees show another configuration: their compound eyes and behavioural repertoire suggest they can judge relative position with considerable accuracy in both forward and lateral directions, supporting flight control and the assessment of landmarks during navigation. Desert ants provide a further variant, relying less on detailed shapes and more on sky-based cues; their performance implies robust sensitivity to polarised light, allowing orientation even when landmarks are scarce. Across these examples, the principle is consistent: species operating in open, sunlit spaces can exploit long sightlines, whereas those in turbid,



shaded or enclosed environments gain little from maintaining expensive visual machinery and often invest more heavily in alternative channels.

Acoustic signalling, finally, is selective rather than universal. Because cricket song is conspicuous, airborne hearing is sometimes assumed to dominate insect communication; yet many ants and termites lack specialised organs for long-distance hearing, and where sound occurs it may be incidental rather than a primary system. Among those insects that do depend on sound, most large crickets both produce and receive acoustic signals; they usually use low frequencies, and their repertoire can be relatively limited in structure even when volume is impressive. Exceptions exist. Tree crickets and hump-winged katydids can produce calls that appear almost song-like in patterned repetition and variation. The broader pattern remains one of constraint-driven specialisation: different habitats and behavioural demands favour different channels, and no single modality wins across all contexts. Nonetheless, chemical signalling stands out as unusually elaborated across a remarkably wide range of taxa, functioning both as identity code and behavioural trigger where other channels falter.

Questions 14–21

Complete the table below. Choose **NO MORE THAN TWO WORDS** from the text for each answer.

Sense	Species	Ability/Comment
Smell (chemical)	Termites (soil/wood-dwelling)	Depend on colony-specific blends as well as 14; neural tissue conspicuous.
	Daylight-hunting wasps	Not dominant; selection may favour faster channels.
Taste	Some ants	Ability limited; receptors on the 15 are sparse.
Touch	Colony insects	Tactile sequences integrated into courtship; antenna bases sensitive.
Vision	16	Eyes reduced; register coarse brightness.
	Honeybees	Judge relative position forward and 17



Sense	Species	Ability/Comment
	18	Robust sensitivity to 19
Hearing (airborne sound)	Most large crickets	Usually use 20; repertoire limited.
	21 crickets and hump-winged katydids	Calls almost song-like.

Questions 22–26

Answer the questions below. Choose **NO MORE THAN THREE WORDS** from the text for each answer.

22 Which type of cues is described as reducing rejection immediately before mating?

23 What do paper wasps pursue when their depth perception is probably limited?

24 What can species living in bright open environments exploit?

25 For which two insect groups may sound serve only a secondary role?

26 Which signalling mode is said to function both as identity code and behavioural trigger?

Answer Key

14. odour trails

15. mouthparts

16. subterranean termites

17. lateral

18. Desert ants

19. polarised light

20. low frequencies



21. tree

22. tactile cues

23. moving objects

24. long sightlines

25. ants and termites

26. chemical signalling