

**Questions 22-31 are based on the following passage.**

This passage is adapted from Patricia Waldron, “Why Birds Fly in a V Formation.” ©2014 by American Association for the Advancement of Science.

Anyone watching the autumn sky knows that migrating birds fly in a V formation, but scientists have long debated why. A new study of ibises finds that these big-winged birds carefully position their wingtips and sync their flapping, presumably to catch the preceding bird’s updraft—and save energy during flight.

There are two reasons birds might fly in a V formation: It may make flight easier, or they’re simply following the leader. Squadrons of planes can save fuel by flying in a V formation, and many scientists suspect that migrating birds do the same. Models that treated flapping birds like fixed-wing airplanes estimate that they save energy by drafting off each other, but currents created by airplanes are far more stable than the oscillating eddies coming off of a bird. “Air gets pretty unpredictable behind a flapping wing,” says James Usherwood, a locomotor biomechanist at the Royal Veterinary College at the University of London in Hatfield, where the research took place.

The study, published in *Nature*, took advantage of an existing project to reintroduce endangered northern bald ibises (*Geronticus eremita*) to Europe. Scientists used a microlight plane to show hand-raised birds their ancestral migration route from Austria to Italy. A flock of 14 juveniles carried data loggers specially built by Usherwood and his lab. The device’s GPS determined each bird’s flight position to within 30 cm, and an accelerometer showed the timing of the wing flaps.

Just as aerodynamic estimates would predict, the birds positioned themselves to fly just behind and to the side of the bird in front, timing their wing beats to catch the uplifting eddies. When a bird flew directly behind another, the timing of the flapping reversed so that it could minimize the effects of the downdraft coming off the back of the bird’s body. “We didn’t think this was possible,” Usherwood says, considering that the feat requires careful flight and incredible awareness of one’s neighbors. “Perhaps these big V formation birds can be thought of quite like an airplane with wings that go up and down.”

The findings likely apply to other long-winged birds, such as pelicans, storks, and geese, Usherwood says. Smaller birds create more complex wakes that would make drafting too difficult. The researchers did not attempt to calculate the bird’s energy savings because the necessary physiological measurements would be too invasive for an endangered species. Previous studies estimate that birds can use 20 percent to 30 percent less energy while flying in a V.

“From a behavioral perspective it’s really a breakthrough,” says David Lentink, a mechanical engineer at Stanford University in Palo Alto, California, who was not involved in the work. “Showing that birds care about syncing their wing beats is definitely an important insight that we didn’t have before.”

Scientists do not know how the birds find that aerodynamic sweet spot, but they suspect that the animals align themselves either by sight or by sensing air currents through their feathers. Alternatively, they may move around until they find the location with the least resistance. In future studies, the researchers will switch to more common birds, such as pigeons or geese. They plan to investigate how the animals decide who sets the course and the pace, and whether a mistake made by the leader can ripple through the rest of the flock to cause traffic jams.

“It’s a pretty impressive piece of work as it is, but it does suggest that there’s a lot more to learn,” says Ty Hedrick, a biologist at the University of North Carolina, Chapel Hill, who studies flight aerodynamics in birds and insects. However they do it, he says, “birds are awfully good hang-glider pilots.”

22

The main purpose of the passage is to

- A) describe how squadrons of planes can save fuel by flying in a V formation.
- B) discuss the effects of downdrafts on birds and airplanes.
- C) explain research conducted to study why some birds fly in a V formation.
- D) illustrate how birds sense air currents through their feathers.

23

The author includes the quotation “Air gets pretty unpredictable behind a flapping wing” (lines 17-18) to

- A) explain that the current created by a bird differs from that of an airplane.
- B) stress the amount of control exerted by birds flying in a V formation.
- C) indicate that wind movement is continuously changing.
- D) emphasize that the flapping of a bird’s wings is powerful.

24

What can reasonably be inferred about the reason Usherwood used northern bald ibises as the subjects of his study?

- A) The ibises were well acquainted with their migration route.
- B) Usherwood knew the ibises were familiar with carrying data loggers during migration.
- C) The ibises have a body design that is similar to that of a modern airplane.
- D) The ibises were easily accessible for Usherwood and his team to track and observe.

25

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 3-7 (“A new . . . flight”)
- B) Lines 10-12 (“Squadrons . . . same”)
- C) Lines 22-24 (“The study . . . Europe”)
- D) Lines 29-31 (“The device’s . . . flaps”)

26

What is the most likely reason the author includes the 30 cm measurement in line 30?

- A) To demonstrate the accuracy with which the data loggers collected the data
- B) To present recorded data about how far an ibis flies between successive wing flaps
- C) To provide the wingspan length of a juvenile ibis
- D) To show how far behind the microlight plane each ibis flew

27

What does the author imply about pelicans, storks, and geese flying in a V formation?

- A) They communicate with each other in the same way as do ibises.
- B) They have the same migration routes as those of ibises.
- C) They create a similar wake to that of ibises.
- D) They expend more energy than do ibises.

28

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 35-38 (“When . . . body”)
- B) Lines 47-48 (“Smaller . . . difficult”)
- C) Lines 52-54 (“Previous . . . a V”)
- D) Lines 66-67 (“Alternatively . . . resistance”)

29

What is a main idea of the seventh paragraph (lines 62-73)?

- A) Different types of hierarchies exist in each flock of birds.
- B) Mistakes can happen when long-winged birds create a V formation.
- C) Future research will help scientists to better understand V formations.
- D) Long-winged birds watch the lead bird closely to keep a V formation intact.

30

The author uses the phrase “aerodynamic sweet spot” in line 63 most likely to

- A) describe how the proper structural design of an airplane helps to save fuel.
- B) show that flying can be an exhilarating experience.
- C) describe the birds’ synchronized wing movement.
- D) suggest that a certain position in a V formation has the least amount of wind resistance.

31

As used in line 72, “ripple” most nearly means

- A) fluctuate.
- B) spread.
- C) wave.
- D) undulate.