Questions 42-52 are based on the following passage.

This passage is adapted from Daniel Chamovitz, *What a Plant Knows: A Field Guide to the Senses*. ©2012 by Daniel Chamovitz.

The Venus flytrap [*Dionaea muscipula*] needs to know when an ideal meal is crawling across its leaves. Closing its trap requires a huge expense of energy, and reopening the trap can take several hours, so *Dionaea* only wants to spring closed when it's sure that the dawdling insect visiting its surface is large enough to be worth its time. The large black hairs on their lobes allow the Venus flytraps to literally feel their prey, and they act as triggers that spring the trap closed when the proper prey makes its way across the trap. If the insect touches just one hair, the trap will not spring shut; but a large enough bug will likely touch two hairs within about twenty seconds, and that signal springs the Venus flytrap into action.

We can look at this system as analogous to short-term memory. First, the flytrap encodes the information (forms the memory) that something (it doesn't know what) has touched one of its hairs. Then it stores this information for a number of seconds (retains the memory) and finally retrieves this information (recalls the memory) once a second hair is touched. If a small ant takes a while to get from one hair to the next, the trap will have forgotten the first touch by the time the ant brushes up against the next hair. In other words, it loses the storage of the information, doesn't close, and the ant happily meanders on. How does the plant encode and store the information from the unassuming bug's encounter with the first hair? How does it remember the first touch in order to react upon the second?

Scientists have been puzzled by these questions ever since John Burdon-Sanderson's early report on the physiology of the Venus flytrap in 1882. A century later, Dieter Hodick and Andreas Sievers at the University of Bonn in Germany proposed that the flytrap stored information regarding how many hairs have been touched in the electric charge of its leaf. Their model is quite elegant in its simplicity. In their studies, they discovered that touching a trigger hair on the Venus flytrap causes an electric action potential [a temporary reversal in the electrical polarity of a cell membrane] that induces calcium channels to open in the trap (this coupling of action potentials and the opening of calcium channels is similar to the processes that occur during communication between human neurons), thus causing a rapid increase in the concentration of calcium ions.

They proposed that the trap requires a relatively high concentration of calcium in order to close and that a single action potential from just one trigger hair being touched does not reach this level. Therefore, a second hair needs to be stimulated to push the calcium concentration over this threshold and spring the trap. The encoding of the information requires maintaining a high enough level of calcium so that a second increase (triggered by touching the second hair) pushes the total concentration of calcium over the threshold. As the calcium ion concentrations dissipate over time, if the second touch and potential don't happen quickly, the final concentration after the second trigger won't be high enough to close the trap, and the memory is lost.

Subsequent research supports this model. Alexander Volkov and his colleagues at Oakwood University in Alabama first demonstrated that it is indeed electricity that causes the Venus flytrap to close. To test the model they rigged up very fine electrodes and applied an electrical current to the open lobes of the trap. This made the trap close without any direct touch to its trigger hairs (while they didn't measure calcium levels, the current likely led to increases). When they modified this experiment by altering the amount of electrical current, Volkov could determine the exact electrical charge needed for the trap to close. As long as fourteen microcoulombs—a tiny bit more than the static electricity generated by rubbing two balloons together—flowed between the two electrodes, the trap closed. This could come as one large burst or as a series of smaller charges within twenty seconds. If it took longer than twenty seconds to accumulate the total charge, the trap would remain open.

CONTINUE

42

The primary purpose of the passage is to

A) discuss findings that offer a scientific explanation for the Venus flytrap's closing action.

B) present research that suggests that the Venus flytrap's predatory behavior is both complex and unique among plants.

C) identify the process by which the Venus flytrap's closing action has evolved.

D) provide a brief overview of the Venus flytrap and its predatory behavior.

43

Based on the passage, a significant advantage of the Venus flytrap's requirement for multiple triggers is that it

A) enables the plant to identify the species of its prey.

B) conserves the plant's calcium reserves.

C) safeguards the plant's energy supply.

D) prevents the plant from closing before capturing its prey.

44

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

A) Lines 3-7 ("Closing . . . time")

B) Lines 7-11 ("The large . . . across the trap")

C) Lines 11-14 ("If the . . . action")

D) Lines 16-18 ("First . . . hairs")

45

The use of the phrases "dawdling insect" (line 6), "happily meanders" (line 27), and "unassuming bug's encounter" (lines 28-29) in the first two paragraphs establishes a tone that is

A) academic.

B) melodramatic.

C) informal.

D) mocking.

46

In the second paragraph (lines 15-31), the discussion of short-term memory primarily functions to

A) clarify an explanation of what prompts the Venus flytrap to close.

B) advance a controversial hypothesis about the function of electric charges found in the leaf of the Venus flytrap.

C) stress the distinction between the strategies of the Venus flytrap and the strategies of human beings.

D) emphasize the Venus flytrap's capacity for retaining detailed information about its prey.

47

According to the passage, which statement best explains why the Venus flytrap requires a second trigger hair to be touched within a short amount of time in order for its trap to close?

A) The second trigger produces an electrical charge that reverses the charge produced by the first trigger.

B) The second trigger stabilizes the surge of calcium ions created by the first trigger.

C) The second trigger prompts the calcium channels to open.

D) The second trigger provides a necessary supplement to the calcium concentration released by the first trigger.

48

Which choice describes a scenario in which Hodick and Sievers's model predicts that a Venus flytrap will NOT close around an insect?

A) A large insect's second contact with the plant's trigger hairs results in a total calcium ion concentration above the trap's threshold.

B) A large insect makes contact with a second trigger hair after a period of inactivity during which calcium ion concentrations have diminished appreciably.

C) A large insect's contact with the plant's trigger hairs causes calcium channels to open in the trap.

D) A large insect's contact with a second trigger hair occurs within ten seconds of its contact with the first trigger hair.

49

As used in line 67, "demonstrated" most nearly means

A) protested.

B) established.

C) performed.

D) argued.

CONTINUE

50

Based on the passage, what potential criticism might be made of Volkov's testing of Hodick and Sievers's model?

A) Volkov's understanding of Hodick and Sievers's model was incorrect.
B) Volkov's measurements did not corroborate a central element of Hodick and Sievers's model.
C) Volkov's direct application of an electrical current would have been objectionable to Hodick and Sievers.
D) Volkov's technology was not available to Hodick and Sievers.

51

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

A) Lines 66-69 ("Alexander . . . close")
B) Lines 69-71 ("To test . . . trap")
C) Lines 71-74 ("This . . . increases")
D) Lines 74-77 ("When . . . close")

52

Based on the passage, in studying the Venus flytrap, Volkov and his colleagues made the most extensive use of which type of evidence?

A) Mathematical models to predict the electrical charge required to close the Venus flytrap
B) Analysis of data collected from previous researchers' work involving the Venus flytrap's response to electricity
C) Information obtained from monitoring the Venus flytrap's response to varying amounts of electrical current
D) Published theories of scientists who developed earlier models of the Venus flytrap

STOP

If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.