Questions 43-52 are based on the following passage and supplementary material.

This passage is adapted from Geoffrey Giller, "Long a Mystery, How 500-Meter-High Undersea Waves Form Is Revealed." ©2014 by Scientific American.

Some of the largest ocean waves in the world are nearly impossible to see. Unlike other large waves, these rollers, called internal waves, do not ride the ocean surface. Instead, they move underwater, undetectable without the use of satellite imagery or sophisticated monitoring equipment. Despite their hidden nature, internal waves are fundamental parts of ocean water dynamics, transferring heat to the ocean depths and bringing up cold water from below. And they can reach staggering heights—some as tall as skyscrapers.

Because these waves are involved in ocean mixing and thus the transfer of heat, understanding them is crucial to global climate modeling, says Tom Peacock, a researcher at the Massachusetts Institute of Technology. Most models fail to take internal waves into account. "If we want to have more and more accurate climate models, we have to be able to capture processes such as this," Peacock says.

Peacock and his colleagues tried to do just that. Their study, published in November in *Geophysical Research Letters*, focused on internal waves generated in the Luzon Strait, which separates Taiwan and the Philippines. Internal waves in this region, thought to be some of the largest in the world, can reach about 500 meters high. "That's the same height as the Freedom Tower that's just been built in New York," Peacock says.

Although scientists knew of this phenomenon in the South China Sea and beyond, they didn't know exactly how internal waves formed. To find out, Peacock and a team of researchers from M.I.T. and Woods Hole Oceanographic Institution worked with France's National Center for Scientific Research using a giant facility there called the Coriolis Platform. The rotating platform, about 15 meters (49.2 feet) in diameter, turns at variable speeds and can simulate Earth's rotation. It also has walls, which means scientists can fill it with water and create accurate, large-scale simulations of various oceanographic scenarios.

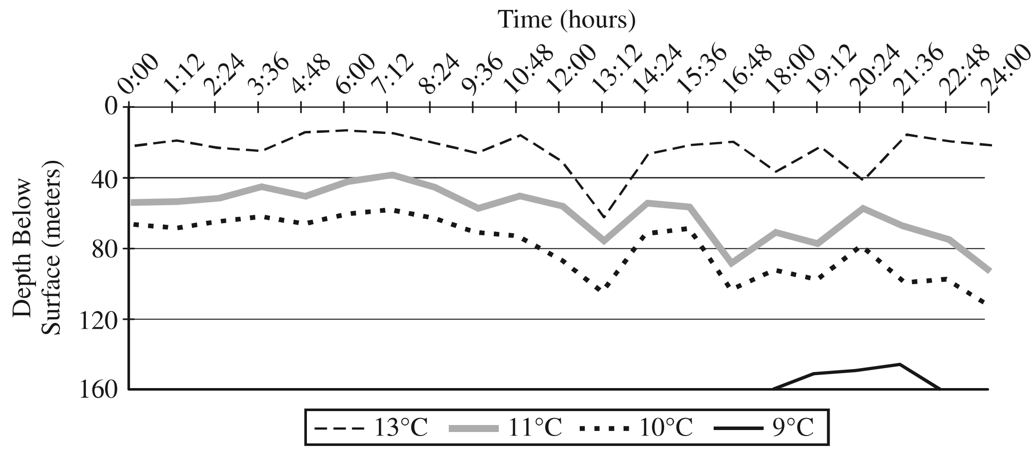
Peacock and his team built a carbon-fiber resin scale model of the Luzon Strait, including the islands and surrounding ocean floor topography. Then they filled the platform with water of varying salinity to replicate the different densities found at the strait, with denser, saltier water below and lighter, less briny water above. Small particles were added to the solution and illuminated with lights from below in order to track how the liquid moved. Finally, they re-created tides using two large plungers to see how the internal waves themselves formed.

The Luzon Strait's underwater topography, with a distinct double-ridge shape, turns out to be responsible for generating the underwater waves. As the tide rises and falls and water moves through the strait, colder, denser water is pushed up over the ridges into warmer, less dense layers above it. This action results in bumps of colder water trailed by warmer water that generate an internal wave. As these waves move toward land, they become steeper—much the same way waves at the beach become taller before they hit the shore—until they break on a continental shelf.

The researchers were also able to devise a mathematical model that describes the movement and formation of these waves. Whereas the model is specific to the Luzon Strait, it can still help researchers understand how internal waves are generated in other places around the world. Eventually, this information will be incorporated into global climate models, making them more accurate. "It's very clear, within the context of these [global climate] models, that internal waves play a role in driving ocean circulations," Peacock says.

CONTINUE

CHANGES IN DEPTH OF ISOTHERMS*
IN AN INTERNAL WAVE OVER A 24-HOUR PERIOD



* Bands of water of constant temperatures

Adapted from Justin Small et al., "Internal Solitons in the Ocean: Prediction from SAR." ©1998 by Oceanography, Defence Evaluation and Research Agency.

43

The first paragraph serves mainly to

A) explain how a scientific device is used.
B) note a common misconception about an event.
C) describe a natural phenomenon and address its importance.
D) present a recent study and summarize its findings.

44

As used in line 19, "capture" is closest in meaning to

A) control.
B) record.
C) secure.
D) absorb.

45

According to Peacock, the ability to monitor internal waves is significant primarily because

A) it will allow scientists to verify the maximum height of such waves.
B) it will allow researchers to shift their focus to improving the quality of satellite images.
C) the study of wave patterns will enable regions to predict and prevent coastal damage.
D) the study of such waves will inform the development of key scientific models.

46

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

A) Lines 1-2 ("Some . . . see")
B) Lines 4-6 ("they . . . equipment")
C) Lines 17-19 ("If . . . this")
D) Lines 24-26 ("Internal . . . high")

47

As used in line 65, "devise" most nearly means

A) create.

B) solve.

C) imagine.

D) begin.

48

Based on information in the passage, it can reasonably be inferred that all internal waves

A) reach approximately the same height even though the locations and depths of continental shelves vary.

B) may be caused by similar factors but are influenced by the distinct topographies of different regions.

C) can be traced to inconsistencies in the tidal patterns of deep ocean water located near islands.

D) are generated by the movement of dense water over a relatively flat section of the ocean floor.

49

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

A) Lines 29-31 ("Although . . . formed")

B) Lines 56-58 ("As the . . . it")

C) Lines 61-64 ("As these . . . shelf")

D) Lines 67-70 ("Whereas . . . world")

50

In the graph, which isotherm displays an increase in depth below the surface during the period 19:12 to 20:24?

A) 9°C

B) 10°C

C) 11°C

D) 13°C

51

Which concept is supported by the passage and by the information in the graph?

A) Internal waves cause water of varying salinity to mix.

B) Internal waves push denser water above layers of less dense water.

C) Internal waves push bands of cold water above bands of warmer water.

D) Internal waves do not rise to break the ocean's surface.

52

How does the graph support the author's point that internal waves affect ocean water dynamics?

A) It demonstrates that wave movement forces warmer water down to depths that typically are colder.

B) It reveals the degree to which an internal wave affects the density of deep layers of cold water.

C) It illustrates the change in surface temperature that takes place during an isolated series of deep waves.

D) It shows that multiple waves rising near the surface of the ocean disrupt the flow of normal tides.

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.