Passage IV

NATURAL SCIENCE: This passage is adapted from the article "Worlds Apart: Seeking New Earths" by Timothy Ferris (©2009 by National Geographic Society).

It took humans thousands of years to explore our own planet and centuries to comprehend our neighboring planets, but nowadays new worlds are being discovered every week. To date, astronomers have identified more than 370 "exoplanets," worlds orbiting stars other than the sun. Many are strange. There's an Icarus-like "hot Saturn" 260 light-years from Earth, whirling around its parent star so rapidly that a year there lasts less than three days. Circling another star 150 light-years out is a scorched "hot Jupiter," whose upper atmosphere is being blasted off to form a gigantic, comet-like tail. Three benighted planets have been found orbiting a pulsar—the remains of a once mighty star shrunk into a spinning atomic nucleus the size of a city—while untold numbers of worlds have evidently fallen into their suns or been flung out of their systems to become "floaters" that wander in eternal darkness.

Amid such exotica, scientists are eager for a hint of the familiar: planets resembling Earth, orbiting their stars at just the right distance—neither too hot nor too cold—to support life as we know it. No planets quite like our own have yet been found, presumably because they're inconspicuous. To see a planet as small and dim as ours amid the glare of its star is like trying to see a firefly in a fireworks display; to detect its gravitational influence on the star is like listening for a cricket in a tornado. Yet by pushing technology to the limits, astronomers are rapidly approaching the day when they can find another Earth and interrogate it for signs of life.

Only 11 exoplanets, all of them big and bright and conveniently far away from their stars, have as yet had their pictures taken. Most of the others have been detected by using the spectroscopic Doppler technique, in which starlight is analyzed for evidence that the star is being tugged ever so slightly back and forth by the gravitational pull of its planets. In recent years astronomers have refined the Doppler technique so exquisitely that they can now tell when a star is pulled from its appointed rounds by only one meter a second—about human walking speed. That's sufficient to detect a giant planet in a big orbit, or a small one if it's very close to its star, but not an Earth at anything like our Earth's 93-million-mile distance from its star. The Earth tugs the sun around at only one-tenth walking speed, or about the rate that an infant can crawl; astronomers cannot yet prize out so tiny a signal from the light of a distant star.

Another approach is to watch a star for the slight periodic dip in its brightness that will occur should an orbiting planet circle in front of it and block a fraction of its light. At most a tenth of all planetary systems are likely to be oriented so that these mini-eclipses, called transits, are visible from Earth, which means that astronomers may have to monitor many stars patiently to capture just a few transits. The French COROT satellite, now in the third and final year of its prime mission, has discovered seven transiting exoplanets, one of which is only 70 percent larger than Earth.

The United States' Kepler satellite is COROT's more ambitious successor. Launched from Cape Canaveral in March 2008, Kepler is essentially just a big digital camera with a .95-meter aperture and a 95-megapixel detector. It makes wide-field pictures every 30 minutes, capturing the light of more than 100,000 stars in a single patch of sky between the bright stars Deneb and Vega. Computers on Earth monitor the brightness of all those stars over time, alerting humans when they detect the slight dimming that could signal the transit of a planet.

Because that dimming can be mimicked by other phenomena, such as the pulsations of a variable star or a large sunspot moving across a star's surface, the Kepler scientists won't announce the presence of a planet until they have seen it transit at least three times—a wait that may be only a few days or weeks for a planet rapidly circling close to its star but years for a terrestrial twin. By combining Kepler results with Doppler observations, astronomers expect to determine the diameters and masses of transiting planets. If they manage to discover a rocky planet roughly the size of Earth orbiting in the habitable zone—not so close to the star that the planet's water has been baked away, nor so far out that it has frozen into ice—they will have found what biologists believe could be a promising abode for life.

31. Which of the following descriptions best reflects the way the passage is organized?

- **A.** It raises the question of whether exoplanets exist and then presents to an equal extent arguments on both sides.
- **B.** It focuses first on the search for planets, then sharpens that focus to the search for planets like our own.
- **C.** It defines planets, first those in Earth's solar system and then those familiar mostly to astronomers.
- **D.** It refers to mythology, then moves to a technical description of those exoplanets the size of Earth or smaller.

32. The passage makes use of both technical terms and:

- **F.** rhetorical questions.
- **G.** figurative language.
- **H.** excerpts from the writings of astronauts.
- **J.** excerpts from the writings of ancient astronomers.

33. As it is used in line 18, the term *such exotica* refers to:

- **A.** the sophisticated equipment used to locate previously unidentified planets.
- **B.** the contents of our solar system, in particular the planets Jupiter and Saturn.
- **C.** overblown claims about planets far from Earth.
- **D.** planets and solar systems vastly unlike Earth and its solar system.

34. What is the main idea of the second paragraph (lines 18–30)?

- **F.** Recently discovered exoplanets have disappointed scientists.
- **G.** Some exoplanets were once thought to be stars at the center of solar systems.
- **H.** Some recently discovered exoplanets spin on their axis at the same speed that Earth spins on its axis.
- **J.** Planets that resemble Earth are extremely hard to detect.

35. The passage's description of the spectroscopic Doppler technique indicates that it is a method used to identify the:

- **A.** intensity of light reaching Earth from a planet outside Earth's solar system.
- **B.** effect of a planet's gravitational pull on the sun the planet is orbiting.
- **C.** speed at which a planet rotates on its axis.
- **D.** distance between an exoplanet and its former sun.

36. According to the passage, in order to confirm a possible planet using the Kepler method, scientists look for:

- **F.** evidence of water both as a solid and a liquid on the supposed planet.
- **G.** an uninterrupted light originating from the supposed planet.
- **H.** identical results in images of the same location taken 24 hours apart.
- **J.** three occurrences of a slight dimming in a star that strongly indicates a planet's presence.

37. According to the passage, at the time the passage was written, how many exoplanets had had their picture taken?

- **A.** 370
- **B.** 95
- **C.** 11
- **D.** 0

38. According to the passage, which of the following is a capability of the Kepler?

- **F.** It can capture the light of more than 100,000 stars in a single patch of sky.
- **G.** It can determine the distance between an exoplanet and its star.
- **H.** It can travel up to 150 light-years away from Earth.
- **J.** It can determine the surface features of planets well enough to indicate the presence of water.

39. In the passage, Deneb and Vega are identified as:

- **A.** stars at the edges of the area examined by the Kepler.
- **B.** planets that are only 70 percent larger than Earth.
- **C.** scientists pioneering in the field of planet searching.
- **D.** former stars whose traveling light is still visible.

40. According to the passage, what do scientists expect to determine about any given transiting planet by combining Kepler results with Doppler observations?

- **F.** The length of its year
- **G.** Its distance from its sun
- **H.** Its diameter and mass
- **J.** Its distance from Earth

END OF TEST 3

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