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EARTH:
A CLOUD OF ASH COVERS MOST OF EUROPE AFTER A VOLCANO IN ICELAND ERUPTS

KABOOM!

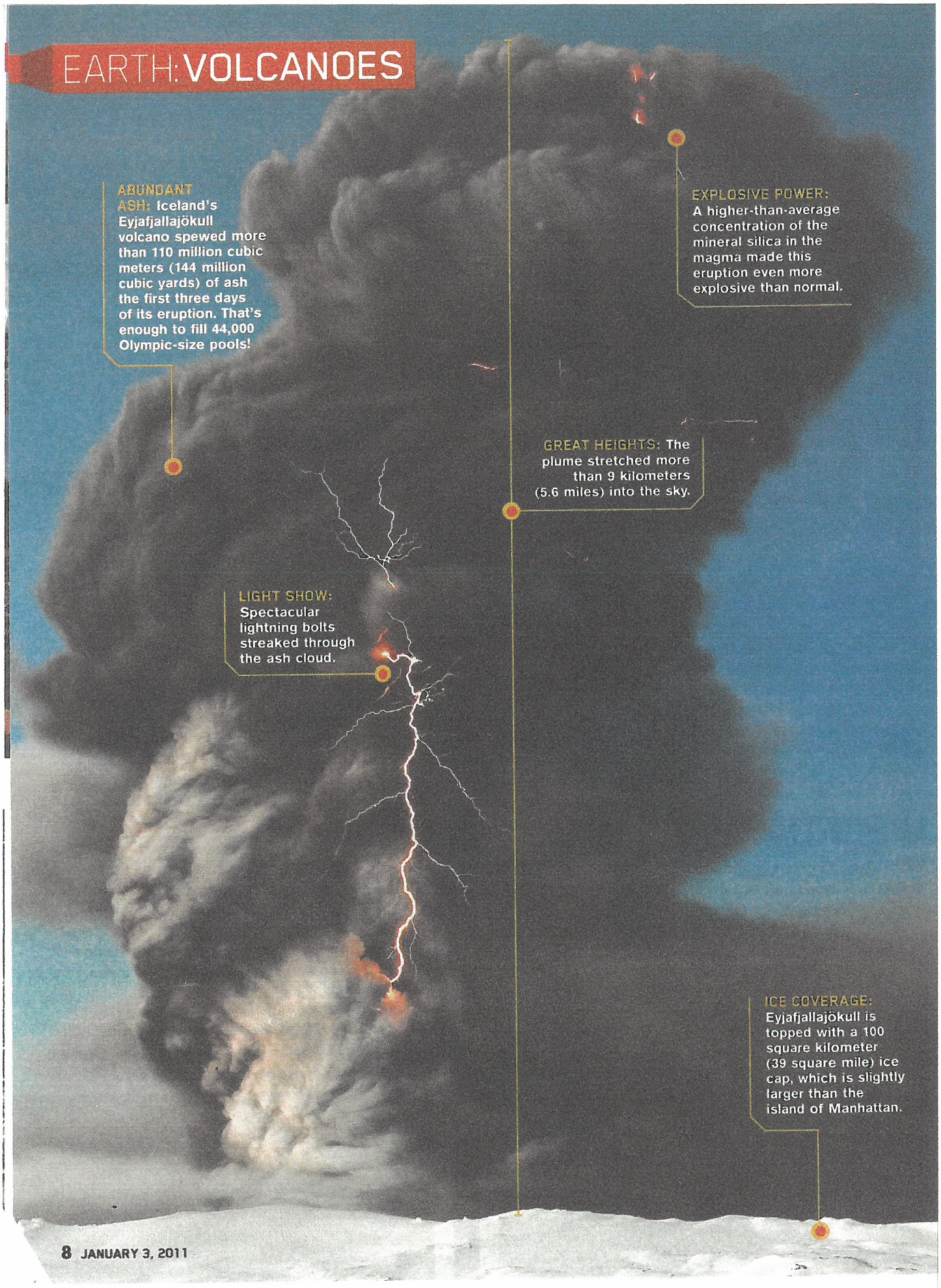
INSIDE:

BIOLOGY:
The Science of Love

PHYSICS:
Pro Skater Tony Hawk's Super Tricks

RECYCLE THIS PLEASE!

EARTH: VOLCANOES



ABUNDANT ASH: Iceland's Eyjafjallajökull volcano spewed more than 110 million cubic meters (144 million cubic yards) of ash the first three days of its eruption. That's enough to fill 44,000 Olympic-size pools!

EXPLOSIVE POWER: A higher-than-average concentration of the mineral silica in the magma made this eruption even more explosive than normal.

GREAT HEIGHTS: The plume stretched more than 9 kilometers (5.6 miles) into the sky.

LIGHT SHOW: Spectacular lightning bolts streaked through the ash cloud.

ICE COVERAGE: Eyjafjallajökull is topped with a 100 square kilometer (39 square mile) ice cap, which is slightly larger than the island of Manhattan.

Fire in the Sky

An enormous ash cloud covers a continent after a glacier-topped volcano erupts

When Iceland's Eyjafjallajökull volcano blew its top last April, it produced an ash cloud that shot more than 9 kilometers (5.6 miles) into the sky. The *jet stream* (band of wind high in the atmosphere) carried the fine ash east, eventually covering most of Europe in a gray haze (*see map, p. 10*). Because ash can damage jet engines, flights to and from Europe were canceled for eight days. It was the biggest disruption to international travel since World War II. Airlines lost an estimated $1.7 billion, and millions of people were stranded as they waited for the ash to settle.

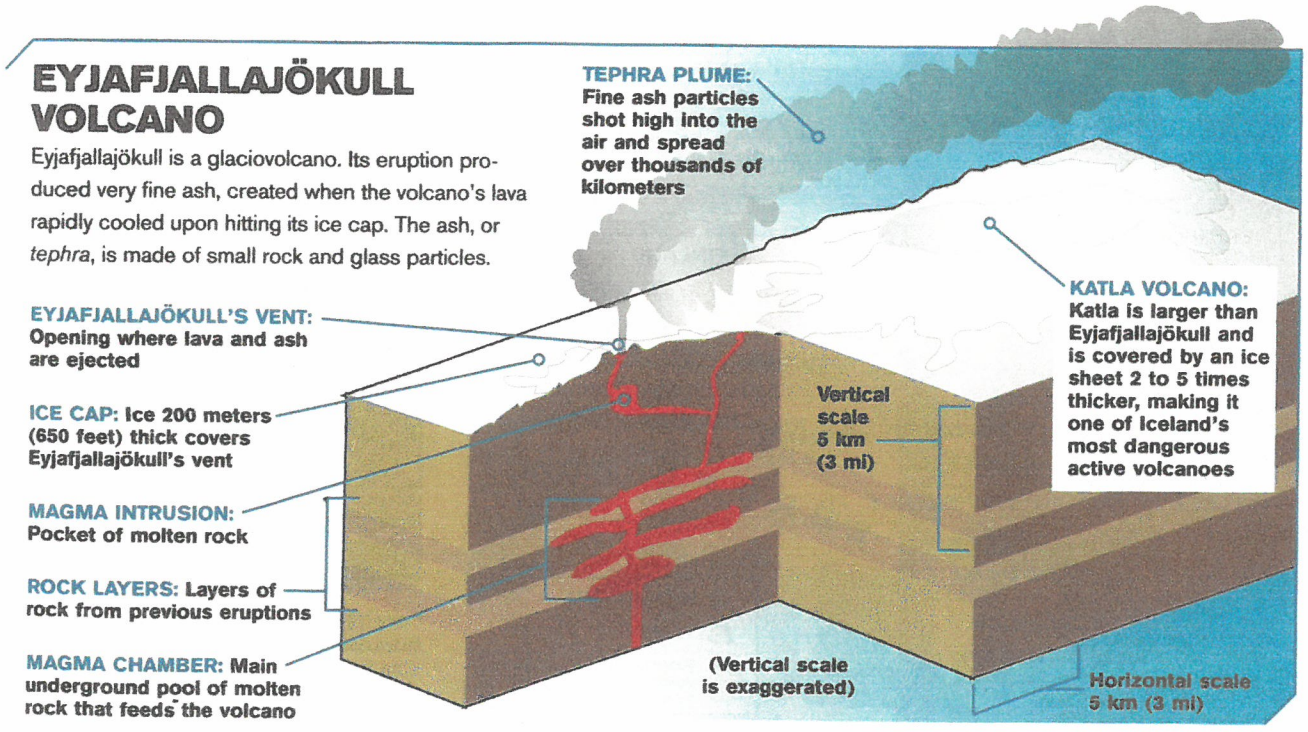
Eyjafjallajökull (AY-ya-FYAT-la-yo-kult) is a *glaciovolcano*, or volcano covered in a thick sheet of ice. When red-hot lava spews from the mouth of a volcano that lies beneath ice, or when lava hits snow-covered slopes, the results can be explosive. The frozen water crackles and pops, instantly boiling into steam. The molten rock bursts into a fiery plume of ash, gas, and rock missiles called *bombs*, ranging in size from that of marbles to SUVs.

In addition to ash, glaciovolcanoes can unleash spectacular lightning shows. The water from melted glaciers also produces *jökulhlaups*, sudden floods caused by the drainage of an ice-dammed lake. Scientists are studying these volcanoes' complex eruptions and their unique hazards to learn more about what happens when fire meets ice.

INSIDE A GLACIOVOLCANO

Volcanoes are openings in the Earth's *crust* through which lava, ash, and gases are ejected. The lava starts out as *magma* (molten rock) under the crust. It rises through the volcano's main *vent*, or vertical tube that connects to the surface.

Sometimes this leads to a *quiet eruption*, with sludgy lava slowly oozing out of the vent. One example of a quiet eruption is Hawaii's Kilauea volcano, which has been continuously



LEFT: GERLEND HAARBERG/NN/SAMFOTO; DIAGRAM RIGHT: KARL TATE LIVESCIENCE

erupting for the past 28 years. Eyjafjallajökull, on the other hand, was an *explosive eruption*. This type of eruption occurs when thicker magma stops up a volcano's vent like a cork in a bottle. Pressure builds underneath the "cork" until it pops. The trapped magma and gases explode through the blockage. Bits of superheated ash, cinders, bombs, and gas hurl into the atmosphere, and then cascade down the volcano's sides in what's called a *pyroclastic flow*.

If the pyroclastic flow or lava encounters snow, ice, or a glacier along the way, the frozen water flashes to steam and quickly cools the flow. "Water is a much better conductor of heat than air, so the water makes the [material] cool much faster," says Ben Edwards, a volcanologist at Dickinson College in Carlisle, Pennsylvania. As a result, a glaciovolcanic eruption usually produces greater amounts of superfine ash than an ordinary volcanic eruption (*see Eyjafjallajökull Volcano, p. 9*). "The melted water causes the magma to break up into very, very small pieces that could travel very, very far," says Edwards.

ELECTRIFYING ERUPTION

In addition to disrupting air travel, an ash cloud also causes changes in the atmosphere. "Volcanic eruptions create their own mini-weather systems," says Ian Skilling, a glaciovolcano expert at the University of Pittsburgh in Pennsylvania. "You can be standing next to a volcanic eruption and it will be pouring rain, but it'll be sunny a bit further away." That's because all of the heat from the lava, ash, and steam rises, mixing up the local air currents. This can lead to hailstones and thunderstorms.

A grain of ash is a tiny piece of porous glass formed when magma cools rapidly. These particles attract water molecules, forming droplets that fall to the ground as rain. The falling rain joins the melted ice running down the volcano and can lead to giant mudslides called *lahars*.

"Whenever a large volcano erupts, there's usually lightning," says Ron Thomas, a lightning researcher at New Mexico Institute of Mining and Technology. Thomas has measured the lightning at four recent eruptions. He's found that the key factor for a good volcanic lightning show is ash. "If there's not much ash, then there's not much lightning," he says.

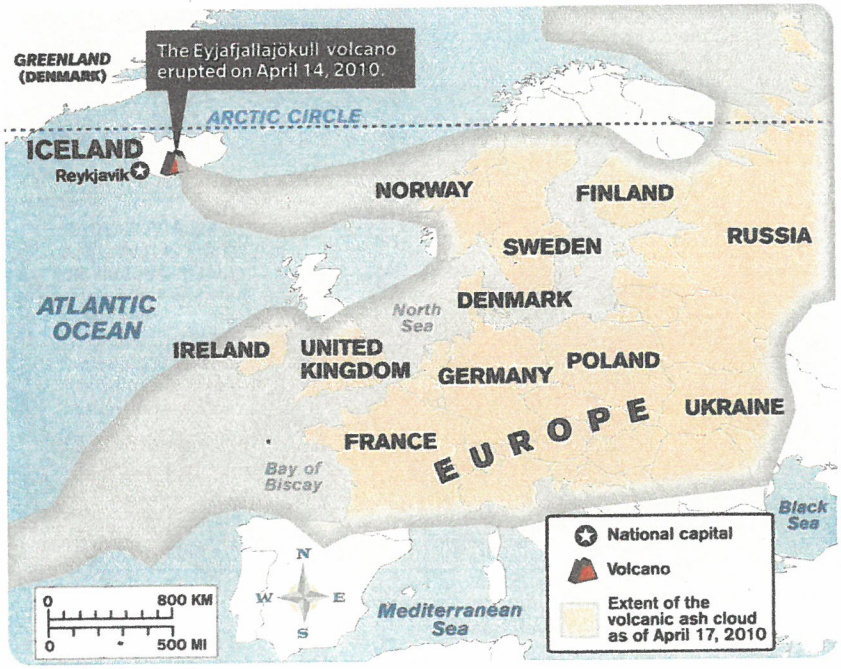
Inside the ash cloud, separate regions of positively and negatively charged particles build up, and then—KABOOM! Lightning strikes as *electrons* (negatively charged particles) flow from the negative region to the positive region, discharging the cloud.

MORE IN STORE

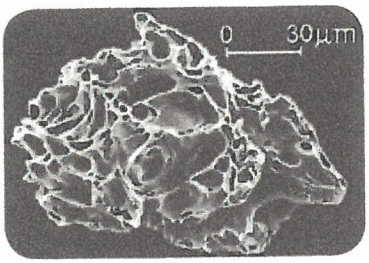
Now that Eyjafjallajökull has quieted down, scientists can take a

INTERRUPTED AIR TRAVEL

Eyjafjallajökull entered its explosive phase on April 14, 2010. By April 17, the ash cloud covered nearly all of Europe. Most of the continent's airspace was closed from April 15 to April 23.



FINE ASH: The 1980 eruption of Mount St. Helens in Washington State produced very fine ash similar to that of Eyjafjallajökull.



TINY TEPHRA: Single ash particles from Mount St. Helens ranged in size from 10 to 300 micrometers (µm)—one thousandth of a millimeter—in diameter.

MAP: JIM MCMAHON; ASH: FROM GRAPHIC BY KARL TATE LIVESCIENCE (2)

HOT SEAT: Onlookers watch as lava cascades down the sides of Eyjafjallajökull.

closer look at the newly formed rock deposits left in the eruption's wake. Studying these formations helps geologists recognize extinct glaciovolcanoes whose ice is long gone.

Approximately 20,000 years ago, much of North America, northern Europe, and Siberia were covered with ice. Those regions now have many steep-sided, flat-topped volcanic mountains called *tuyas* that were formed under glaciers.

Another glaciovolcanic calling card is found in some types of rock called *columnar basalt*. The Devils Postpile in Yosemite, California, is a columnar-basalt formation. It's made of hexagonal tube-shaped rocks, whose pattern might have formed as lava rapidly cooled against a glacier. These preserved features can tell geologists how far south the glaciers once extended, and show how much cooler the planet was when those ancient glaciovolcanoes erupted.

Studying recent eruptions can also help scientists know what to expect from future glaciovolcanic activity. Then researchers can provide emergency planners and airlines with information on how to best prepare for potential hazards.

Several glaciovolcanoes in the U.S. Pacific Northwest and British Columbia have the potential to erupt and cause the same kind of air-traffic problems as Eyjafjallajökull. "There's a bunch of volcanoes there with fairly big ice caps," says Skilling.

These volcanoes are active, but haven't erupted in more than 100 years. If one did blow its top, a giant ice-fueled ash cloud could halt air travel for just as long as—if not longer than—Eyjafjallajökull did last spring.

—Karina Hamalainen

[VIDEO EXTRA] Watch a video of Eyjafjallajökull's eruption at: www.scholastic.com/scienceworld

MAP: JIM MCMAHON; ASH: FROM GRAPHIC BY KARL TATE LIVESCIENCE (2)

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HANDS-ON SCIENCE

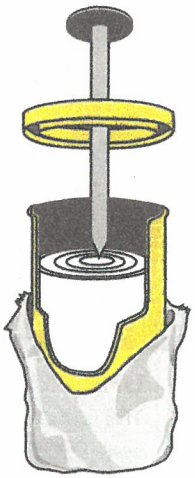
DISCHARGING ELECTRICITY

PREDICT Volcanic ash clouds store and release an electrical charge as lightning. What happens if you touch a charged object?

MATERIALS nail • small plastic container with lid • aluminum foil • water • balloon • wool felt

PROCEDURE

1. Carefully push a nail through the center of the container's lid.
2. Cut a 6-by-11 centimeter (2.5-by-4.3 inch) piece of aluminum foil. Wrap the long edge of the aluminum foil around the container, leaving a small gap at the top edge. Fold the excess foil under so it completely covers the bottom.
3. Fill the container with water and snap the lid on. The nail should touch the water (*see diagram, right*).



4. Inflate the balloon and tie it off.
5. Rub the balloon with a piece of wool felt to create a static charge. Grasp the container in one hand, touching only the foil. Take the balloon and gently touch it to the top of the nail. Repeat this step three more times.
6. Touch the nail with your other hand. Observe what happens.

CONCLUSIONS What happened when you touched the nail? How do you think this is similar to lightning in ash clouds?

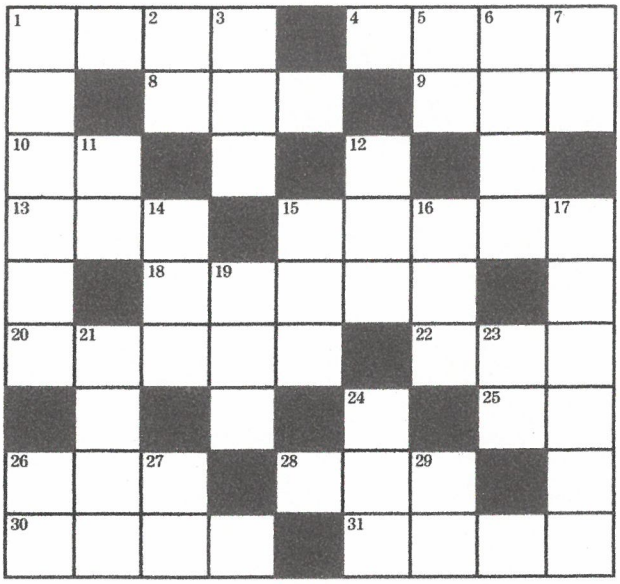
CROSSWORD

ACROSS:

***1.** Molten rock that spews out of volcanoes
***4.** Scientists are studying this rodent to learn about the brain and its role in "falling in love."
8. Local time zone in Oregon (*abbr.*)
9. Warmer than warm
10. Johannesburg is the most populous city in this African country (*abbr.*).
13. Flightless cousin of the ostrich
15. Cone-shape dwelling of Native American tribes in the Great Plains
***18.** To do the 900, a skateboarder ___ 2.5 times in the air.
***20.** When lava meets a glacier, the frozen water instantly boils into ___.
***22.** Glaciovolcanoes are covered by a thick sheet of ___.
25. Element with 18 protons (*chemical symbol*)
26. Center of a hurricane
***28.** Light-show designer George Dodworth combines ___, blue, and green light to create all of the colors of the visible spectrum.
***30.** A half-pipe is a U-shaped ___.
***31.** A new video game in which characters defy the laws of gravity is called ___ *Hawk: SHRED.*

DOWN:

***1.** Concentrated beams of light
2. The White House's second-in-command (*abbr.*)
***3.** Eyjafjallajökull produced a giant plume of superfine ___ that halted plane traffic for eight days.
5. The Buckeye State (*postal code*)
***6.** Oxytocin and vasopressin are two neurotransmitters associated with this feeling.
7. Alien that wanted to phone home
11. Time of day that's the opposite of post meridiem (*abbr.*)



MYSTERY PHOTO

What is This?

Hint: Large varieties of this desert native can store up to 908 liters (240 gallons) of water.