

Science & Medicine

Classified

What does 1991 hold — drought-breaking downpours or more dry skies?
As the year unfolds, here's an opportunity to track the rain that falls in your own back yard

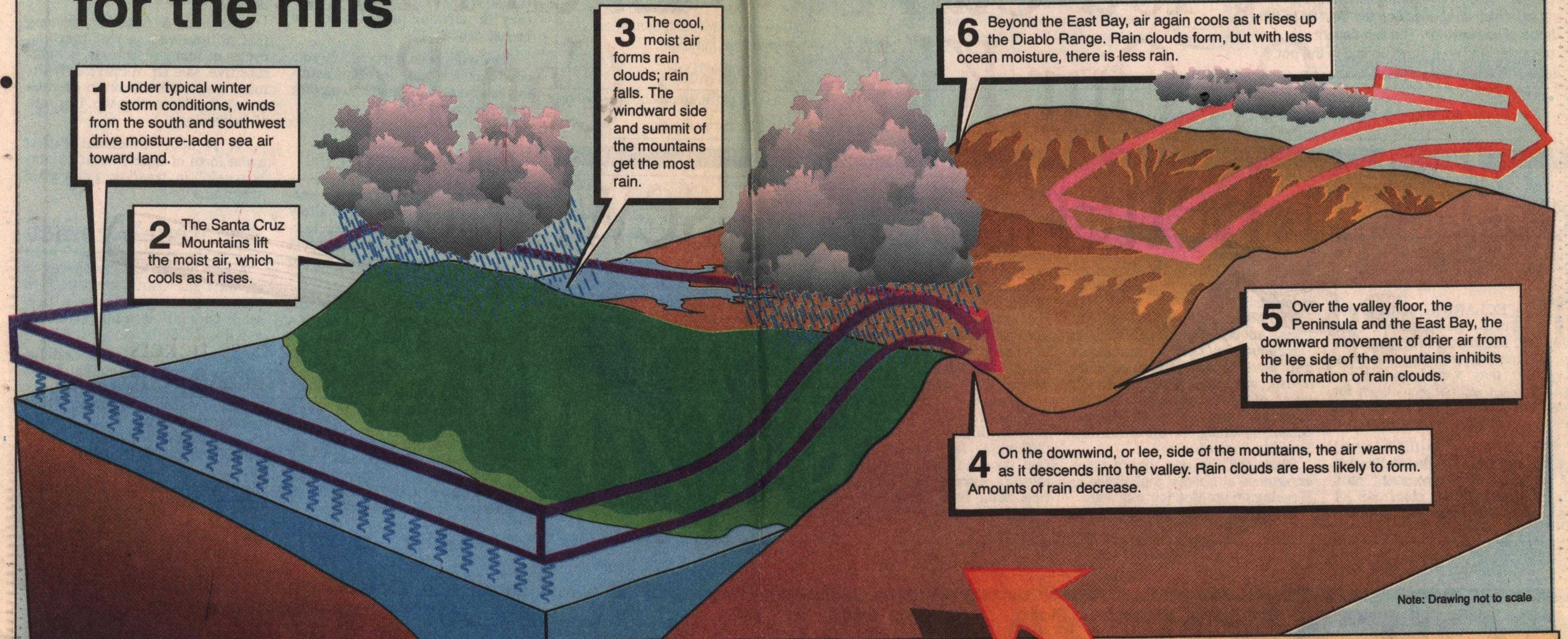
RAIN 1991

Why rain heads for the hills

The Pacific Ocean and the Santa Cruz Mountains help shape weather patterns for the entire Bay

Area. As a result, San Jose and cities on the Peninsula and in the East Bay get about half as much

rain as Santa Cruz. And places like Felton and Big Basin get even more than Santa Cruz.



Note: Drawing not to scale

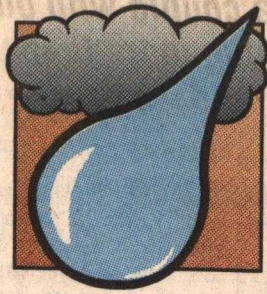
Bay Area rainfall

The center map shows average annual precipitation for the Bay Area calculated over a 30-year period from

Surrounding the map are charts comparing average monthly rainfall before and during the drought for five cities.

Track it yourself

With the charts at right and monthly rainfall totals we'll provide, you can plot 1991's rainfall against the pre-drought and drought averages. At the beginning of each month, Science & Medicine will publish rainfall figures for the previous month for five representative cities. Look for this raindrop symbol.



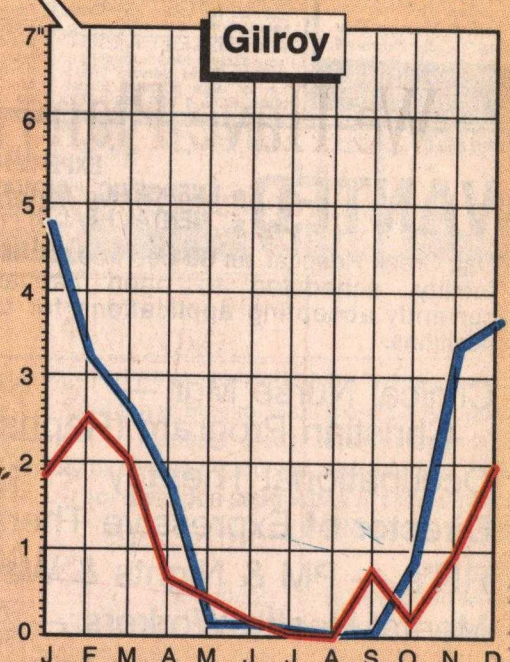
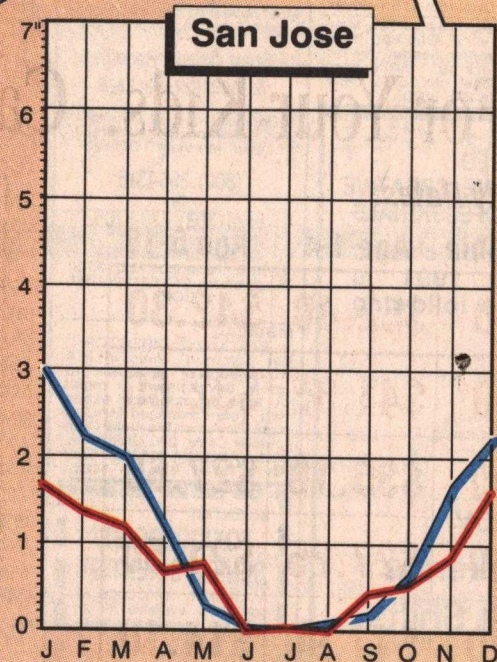
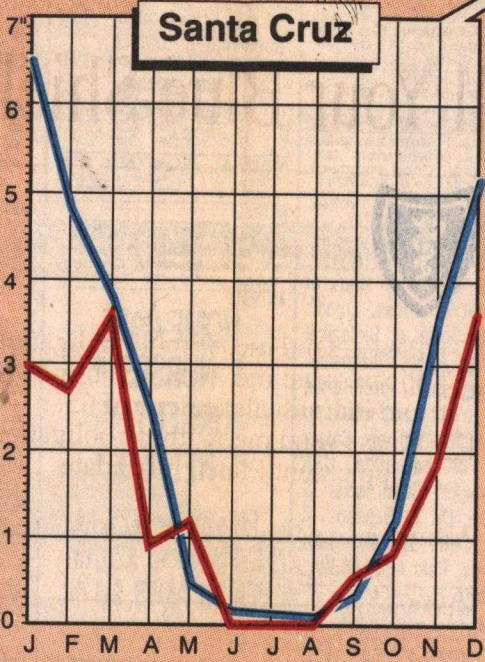
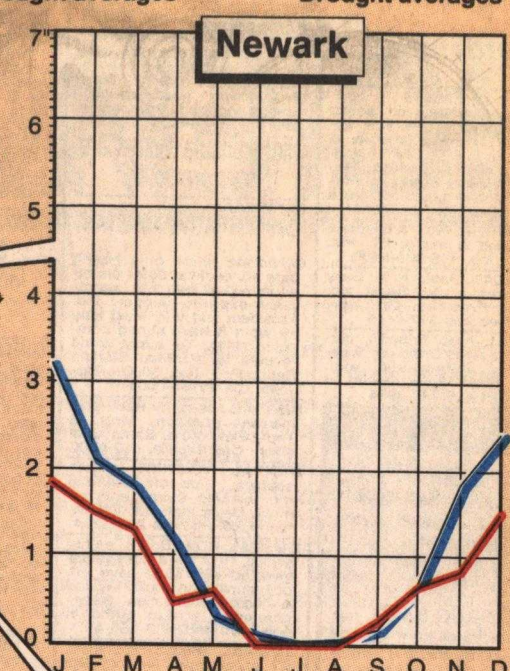
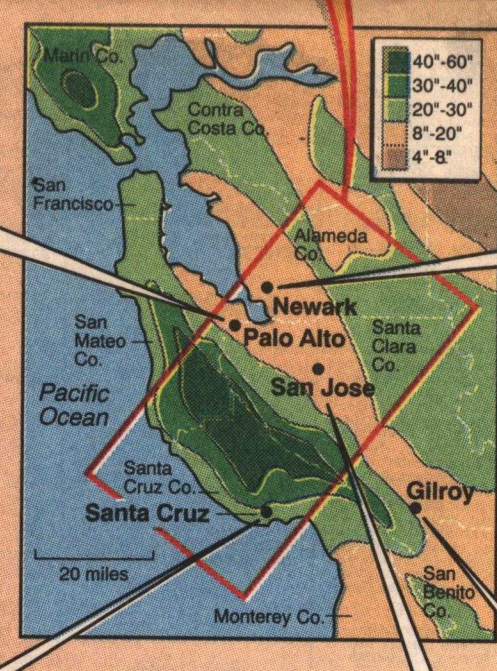
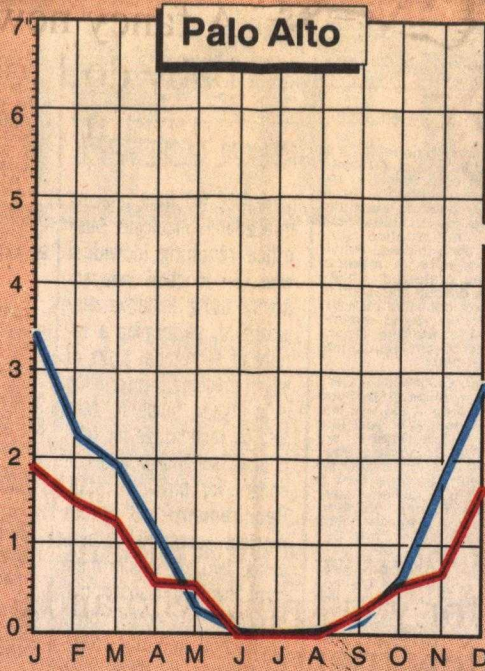
If you want to get really serious, you can measure and chart the rainfall at your home. You will need a rain gauge, a notebook and the dedication to check the gauge and record the amount of rainfall each day it rains.

You can buy a rain gauge for a few dollars at most hardware stores or make one yourself. For instructions on building a rain gauge, send a self-addressed, stamped envelope to Rain Gauge, Science & Medicine, San Jose Mercury News, 750 Ridder Park Drive, San Jose 95190.

Put your rain gauge in an open, unobstructed spot. Each day it rains, check the gauge, record the total rainfall in your notebook and empty the gauge. It's important to check the gauge at the same time each day so your 24-hour totals will be consistent. National Weather Service "cooperative observers" check their gauges at 4 p.m., but you can do it any time.

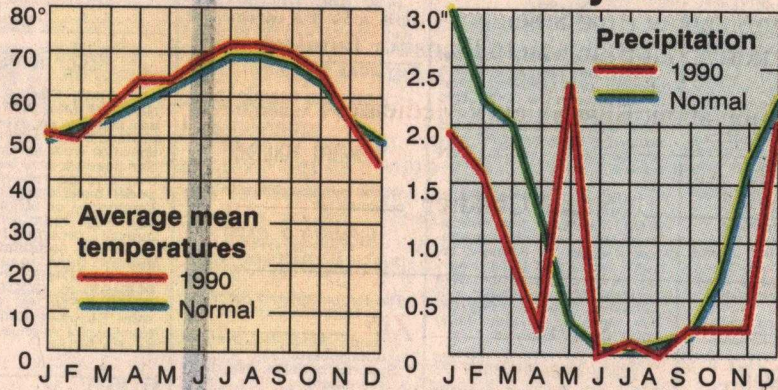
At the end of each month, add the daily totals. You can plot them on any of the charts at right; for comparison, it's best to choose the one that most closely resembles the weather patterns where you live.

1931 to 1960.



Pre-drought averages were calculated based on the number of years records have been kept. (In the Bay Area, that can be anywhere between about 20 and about 80 years.) Drought averages were calculated using monthly rainfall totals from July 1, 1986 to Dec. 31, 1990.

San Jose's 1990 weather year



How much is enough?

Our drought will be over when... well, after it rains a lot. How much? Water officials disagree. Average rainfall this year that came at the right intervals and produced a lot of snowpack and runoff would get us by for the year, but it wouldn't put us ahead for next year. More than average would, of course, be better. Less than average... let's not think about it.

We can determine how far below normal rainfall has been during the drought, but it's impossible to calculate how many inches of rain it would take to fill the 11 reservoirs in Santa Clara County, because the rain doesn't fall out of the sky and pour right into the reservoirs.

The reservoirs are at 8 percent of their 175,448-acre-foot capacity. It would take about

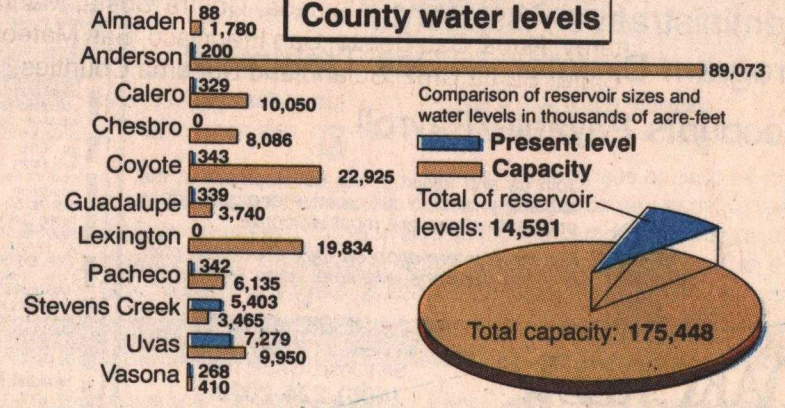
161,920 acre-feet, or 52.8 billion gallons, to fill them to capacity.

An acre-foot is the amount of water it would take to cover an acre a foot deep. That works out to about 326,000 gallons and is often characterized as the amount of water two families of five would use in a year, or the amount it would take to cover a football field (excluding end zones) 11 inches deep.

But what does 161,920 acre-feet amount to in more down-to-earth amounts?

- 1.8 billion bathtubs full.
- 6.4 billion 5-minute showers.
- 4.1 billion toilet flushes.
- Columns of water about a mile and one-eighth high covering the fields (excluding end zones) of all 27 National Football League stadiums.

County water levels



Q&A

Why temperature goes down as you go up

By Marcia Barinaga
Special to the Mercury News

Q Why does the atmosphere get colder as you go up?

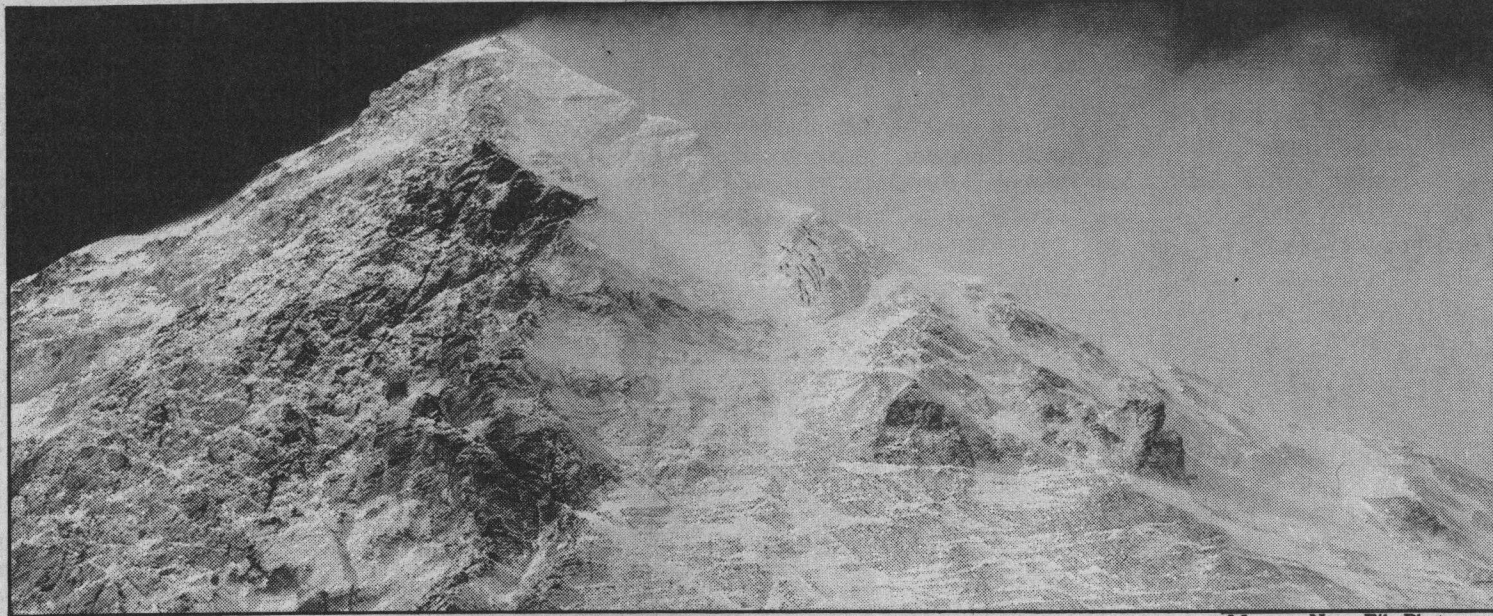
— *Linh Doan,
Frost School, San Jose*

A Rather than being heated directly by the sun, the atmosphere gets most of its heat from the Earth's surface. Air high in the atmosphere is too far from the Earth to directly absorb much of its radiated heat. Air heated at the Earth's surface rises, but rising makes it expand, and that causes it to cool.

Most of the sun's energy passes right through the atmosphere without warming it, according to meteorologist Peter Lester of San Jose State University. After penetrating the atmosphere the sunlight strikes and warms the Earth. The warmed Earth radiates heat that in turn warms the air near its surface.

That warmed air becomes less dense and rises. But atmospheric pressure drops with increasing altitude, and that forces the air to expand as it moves upward. The process of expansion uses up energy that was stored in the air as heat, Lester said, and that cools the rising air.

The result is that air temperature in the lower atmosphere, or troposphere, drops steadily as you go up, reaching a low of minus 40 to minus 60 degrees Celsius at an altitude of about 30,000 feet, a region called the tropopause.



Mercury News File Photograph

To heights of about 30,000 feet — just slightly above Mt. Everest's 29,028-foot peak — the air temperature steadily drops

Above the tropopause is the stratosphere, which contains the ozone layer. Ozone has the ability to absorb some of the sun's energy directly, and thus be warmed. So temperatures in the stratosphere rise with increasing altitude. They reach about zero to minus 20 degrees Celsius at the stratopause, about 150,000 feet above the Earth's surface, before beginning to drop again.

Q Last week the Mercury News ran a story about a woman who drank

three liters of water but still couldn't produce urine for a drug test. Why didn't her bladder burst? How much can your bladder hold, and what happens if you drink more than that?

A The woman's bladder probably wasn't overly full, because her kidneys were not producing much urine. If they had been, her bladder might have stretched to hold a liter of urine, but by then the pain would have forced her to urinate.

The woman had taken a cold medication that raised her levels of vasopressin, a hormone that slows kidney function, according to Dr. David Klonoff, the University of California, San Francisco physician who treated her.

Since her kidneys weren't processing enough of the water she had drunk, it built up in her tissues, throwing off her salt balance and causing faulty brain function.

By the time she arrived at the hospital, the stress of the drug test and the effects of the cold medication had worn off. Her kidney function improved, she relaxed

and, over the next 24 hours, passed the three liters of urine. So her bladder capacity was probably never stretched to its limit.

When you drink water, it first goes to replace fluids you may have lost recently — through sweating, for example. Excess water is removed from your blood by your kidneys within 30 minutes to an hour and deposited in your bladder, according to Emil Tanagho, chairman of urology at UCSF.

A normal bladder holds about half a liter of urine, or about 16 ounces, but can stretch to hold up to about a liter, Tanagho said. People who often ignore the need to urinate can stretch their bladders so that they hold more before they feel full. Others may need to urinate more often because their bladders are more sensitive to the full feeling.

Once your bladder is stretched to its limit, the pain and need to urinate will become too great to ignore, Tanagho said. Nature will take its course, forcing you to urinate.

If you still didn't urinate, perhaps because of a blockage, Tanagho said your bladder would not burst. Instead, urine would back up the tubes to your kidneys, and slow down your kidney function. Then if there was still excess water in your blood, you might be in danger of water intoxication, like the woman in the news report.

Readers are invited to submit questions about science and medicine. Call (408) 920-5858 or write to Science Questions, San Jose Mercury News, 750 Ridder Park Drive, San Jose, Calif. 95190.