

## Who'll get hit by a falling satellite?

NASA says a satellite that has been in orbit since 1991 will break apart and fall back to Earth soon.

By Alan Boyle  
NBC Nightly News, September 10, 2011

Sometime in the next few weeks, NASA expects a refrigerator-sized hunk of a satellite to fall to Earth. But will it hit someone? Not likely. NASA says there's a 1-in-3,200 chance that any pieces of the satellite will hit anyone. In fact, there's a good chance no one will see it when it falls — whenever and wherever that turns out to be.

The space agency and the military personnel who track orbital debris say NASA's six-ton Upper Atmospheric Research Satellite, or UARS, is due to re-enter the atmosphere in late September or perhaps early October. They can't yet say exactly when.

The end of the month or the beginning of next month is still "the best estimate of what we can give right now," said Air Force Maj. Michael Duncan, deputy chief for space situational awareness at the U.S. Strategic Command at California's Vandenberg Air Force Base. "There are so many factors that will affect it between now and that point in time — the atmosphere changes on a daily basis — that it's impossible to say how that's going impact this re-entry from this point in time to then."

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As the bus-sized satellite's orbit descends from its current low point of 140 miles (225 kilometers), the military's Joint Space Operations Center will refine its projections on when it will fall, all the way down to T-minus-2 hours and later. But even when the satellite makes its descent and breaks up in the atmosphere, NASA won't be confident exactly where the pieces will fall.

"We're never really confident," said Nicholas Johnson, chief scientist and program manager for NASA's Orbital Debris Program Office at Johnson Space Center. "Even at ... T-minus-2 hours, there will be a lot of uncertainty. And when I say a lot of uncertainty, we're probably talking plus or minus 10,000 kilometers. We just will not know precisely where it's going to come down until it comes down."

### Long buildup to the end

NASA does know a lot about what the falling satellite will do when it falls, however, in part because they've had a lot of time to think about it.

UARS was deployed from the shuttle Discovery in 1991 to begin a fruitful \$750 million mission studying the upper atmosphere and its interaction with the flux of particles from the sun. It was the first satellite to track the rise and fall of solar activity through the sun's full 11-year cycle, and it nailed down the cause and effect involving chlorofluorocarbon use and the extent of Earth's ozone hole. But in 2005, NASA determined that UARS was no longer fulfilling any scientific function that wasn't being done better by more recently launched satellites, said Paul Hertz, chief scientist for NASA's Science Mission Directorate. So the agency put it into a disposal orbit.

Unfortunately, all of the satellite's propellant was used up when the orbit was changed, so there's nothing left to control when and where the now-inert UARS will make its final, fatal plunge. "It was really not given a lot of thought, and clearly was not part of the mission plan," Johnson said.

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Over the years, Johnson and his colleagues have run models indicating that the satellite would break up during atmospheric re-entry, with 26 different components surviving the descent and falling to Earth's surface. The total mass would be about half a ton, or 500 kilograms. Johnson said the biggest piece would be a part of the satellite's main structure weighing a little more than 300 pounds (150 kilograms, or about the weight of a refrigerator).

Having a refrigerator come down on you from space does not sound like a pleasant prospect, but Johnson emphasized that most space debris falls into an ocean, a desert or some other desolate place. "Throughout the entire 54 years of the Space Age, there has been no confirmed report of anybody in the world being injured or severely impacted by any re-entering debris," he said.

One of the closest calls came in 1978, when the Soviets' nuclear-powered [Cosmos 954 satellite](#) spread radioactive debris over a lightly populated area of northern Canada. The incident caused no confirmed injuries — but it did spark a political uproar in Canada, largely because of the radioactivity and the failure to provide advance warning.

NASA said there are no toxic materials aboard UARS.

### Working out the risk factors

UARS is due to come down somewhere between 57 degrees north latitude and 57 degrees south, which takes in a huge swath of the globe from northern Canada to southern South America. Thus, virtually all of the planet's nearly 7 billion people could theoretically be in the debris zone, but only because of the uncertainty surrounding the time and place of UARS' fall. NASA expects that pieces of debris, including that cosmic refrigerator, would be spread out along a 500-mile-long (800-mile-long) path.

Johnson has run the numbers for the global risk assessment, taking area and population into account. "Numerically it comes out to a chance of 1-in-3,200 that any person anywhere in the world might be struck by a piece of debris," he said.

That may sound like a huge risk, compared with the chances of winning the lottery. But remember, we're talking about the chances of *anyone* being struck. For example, when you buy a ticket for a raffle, there's a 1-out-of-1 chance that someone is going to win. In this case, the 1-in-3,200 chance refers to the probability of any one person losing. The chance that a piece of UARS would strike any particular person — you, for example — is more like 1-out-of-20 trillion.

Here's another way of looking at it: Johnson said that an object as big as UARS descends from orbit every year or so. If his projections are correct, you can expect to hear about a person hit by debris from such an object every 3,200 years.

### Seeing and touching the satellite

The skies over Fiji lit up when fragments of Russia's 138-ton Mir space station [fell through the atmosphere](#) in 2001. Will anyone see anything like that when UARS falls?

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"If they're fortunately positioned, yeah, this should be quite a nice show," Johnson said. The fiery remains should be visible even during daylight. However, because authorities can't predict where the satellite will come down, there are no plans to monitor the skies — or tell skywatchers where to look. So much of Earth's area consists of open ocean, desert or wilderness that there's a good chance no one will see the descent.

"We can't raise people's expectations and tell them to go out and look in their backyard," Johnson said.

Some of the debris might not even be recognizable as parts of a satellite on the ground, but if you do come across the cosmic refrigerator or other parts of the satellite, NASA advises that you leave it alone and call the authorities. Part of the reason has to do with health and liability concerns. "You're much more likely to get a cut by some sharp edge on a piece," Johnson said.

Johnson said there are also legal guidelines governing satellite debris that falls to Earth. "It is still the property of the United States government," he said. If debris falls in the U.S., federal authorities want to take custody of the material. If it falls within the borders of another country, the government has the right to ask for its return, Johnson said.

"No, you don't have the luxury of trying to sell it on eBay," Johnson said.

Johnson recalled a case involving a nose cone from a European Ariane 5 rocket booster that [washed up on a Texas beach in 2000](#). A beachcomber named Barney Corey reportedly ended up with the object and planned to turn it into a hot tub.

"We, however, convinced him with the help of our colleagues at the Department of Justice that that was not an option, and we did retrieve that object," Johnson said "We would do the same thing for any objects recovered in the United States from UARS."

Robert Pearlman said times were different when NASA's Skylab fell from orbit in 1979: Pieces of the space station landed harmlessly in the Australian Outback and soon ended up on the open market. Fragments were incorporated in a wide range of products, including [pens](#) and posters. "Those pieces helped educate the public and got the public interested in space," he said.

Pearlman himself recalls getting a poster from New York's Hayden Planetarium that was accompanied by a smidgen of material from Skylab. "It hung in my room for all my childhood days," he said.

As Pearlman discussed how times have changed, it sounded as if he was almost hoping a piece from UARS would fall in his backyard. Not the cosmic refrigerator, maybe, but enough of a keepsake to revive those childhood memories.

"One wonders what the authorities would say," he mused, "if you said, 'Hey, I found it. ... If you don't need it, can I keep a piece of it?'"

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**Update for 5:45 p.m. ET Sept. 10:** I initially used a comparison to lottery odds as an illustration of a situation where someone is assured of winning, but a commenter pointed out that lotteries don't necessarily guarantee a winner in a particular drawing. A better example would be a raffle, where the winning ticket is drawn out of a hat. Guess it's been a while since I've played the lottery.