I wasn’t going to talk about it and you really didn’t ask, but . . .

Perchlorate pollution is an environmental concern that you might want to know about.
Perchlorate = $\text{ClO}_4^-$

- Perchlorate is a common component of rocket fuel.
- Perchlorate is also used in roadside flares, airbag initiators and in the manufacture of matches.
- Perchlorate has been found in drinking water in 35 states at levels of at least 4 ppb.
- Perchlorate can inhibit the uptake of iodide by the thyroid and may lower the amount of thyroid hormone in the body.
  - Insufficient levels of thyroid hormone can cause permanent neurological damage in children.
Where does perchlorate contamination come from?

- **Perchlorate manufacturing and handling** (36 sites): 21%
- **Other (includes fireworks and flare manufacturing and disposal, general manufacturing, and hazardous waste)** (16 sites): 10%
- **Agriculture** (6 sites): 4%
- **DOD, NASA, and defense-related industries** (includes propellant manufacturing, rocket motor testing, and explosives testing and disposal) (110 sites): 65%

Sources: Environmental Protection Agency, Department of Defense, U.S. Geological Survey, and state environmental agencies.
Perchlorate produced by the Kerr-McGee Chemical Corp. located near Las Vegas has contaminated the lower Colorado River exposing people who live hundreds of miles away from the river.

- For example, water from the lower Colorado is part of the water supply for the cities of Phoenix, Tucson and San Diego.
- It is estimated that about 15 million people are exposed to water from the lower Colorado river.
  - Kevin Mayer of the US EPA San Francisco regional office says, “It’s hard to imagine more people exposed from any one release anywhere in the country.”
A heavily contaminated spring containing perchlorate from the Kerr-McGee plant flows into the Las Vegas Wash. Perchlorate conc. in the wash was as high as 800 ppb.

The Wash is a tributary to Lake Mead.

- Well water in the Torrez Martinez Cahuilla Indian reservation was found to be contaminated after the high prevalence of hypothyroidism among tribal members was noticed.
Kerr-McGee has begun a cleanup.

- But the estimate is that at the current pumping rates it will take 24 years to remove perchlorate from groundwater.
- Also, the cleanup will not remove the 20 million pounds of perchlorate trapped in stream sediments.
  - At the natural flushing rate, the lower Colorado will remain contaminated for the next 50 years.
Cleanup Update

- Sampling data from the Willow Beach, AZ sampling point on the Colorado River showed a reduction from 9.7 ppb in June 1999 to 1.8 ppb in May 2008.

- Sampling data from the Las Vegas Wash showed a reduction from 1,200 ppb in October 1998 to 61 ppb in May 2008.

- For reference, California’s drinking water standard is 6 ppb.
For example, you can be exposed to perchlorate by eating vegetables grown in perchlorate contaminated water.

- The Imperial Irrigation District holds the rights to the largest diversion of flow from the lower Colorado (3 million of the 4.3 million acre feet allocated to California) and uses the water to grow crops in California's Imperial valley.
- A study in Riverside, CA found perchlorate in 18 out of 18 lettuce samples analyzed.
The EPA and the Pentagon are fighting over what the “safe” level of perchlorate in water should be.

- In 1999 the EPA set a provisional range of 4 to 18 ppb as safe.
- As of October 2008, the EPA had declined to set an official MCL for perchlorate because few water systems would be affected.
- Several states have set advisory levels. In N.Y. the advisory level is 5 ppb.
- The Pentagon is advocating a 200 ppb standard.  It should go without saying that this would drastically lower the military’s clean-up costs.
- The Bush Administration asked the National Academy of Sciences to review the data on perchlorate.
The National Research Council’s report is out.

- The safe perchlorate dose according to the NRC report is 0.7μg per kg body weight per day.
  - In contrast, the EPA’s safe dose estimate was .03 μg/kg-d
  - The EPA adopted the NRC’s reference dose in Feb 2005

- The National Resource Defense Counsel (NRDC) charged that the Pentagon and White House collaborated to skew the NRC report to lower the costs of cleaning up perchlorate pollution.
  - The NRC says “We are fiercely independent in our decision making”.

- Human breast milk across the U.S. has recently been shown to have high perchlorate levels. Breast fed babies, on average, drink more than two times the NRC’s recommended safe dose.
So what does the NRC’s 0.7μg per kg body weight per day mean in terms of safe drinking water levels?

- The Environmental Working Group (EWG) estimates the NRC number would translate into a water standard no higher than 2.5 ppb.
- The Nation Resources Defense Council (NRDC) estimates the water standard based on the NRC number could be between 1 and 4 ppb.

I’m not sure how they did their estimate, but if we run the NRC number through our MCLG calculation procedure, we get:

\[ \frac{0.7 \mu g/kg \text{ d}}{2 \text{ L water consumed/d}} \times 70 \text{ kg body weight} \times 20\% = 4.9 \mu g/L \]  
(Note: 1μg/L = 1 ppb)
“EPA will set drinking water standards for the rocket-fuel chemical”

EPA’s decision reverses a policy of the Bush administration not to regulate perchlorate.

A national standard for perchlorate may lead to sizable cleanup liability for the Defense Dept., NASA, and the Dept. of Energy. [These agencies have opposed setting the standard.]
In the mean time watch out for California lettuce.

And, while exploring Mars is great, be aware of the hidden environmental costs associated with rocket propellants.