struments could include an astrobiology payload and a device to measure the depth of the ice pack covering the moon’s surface. The density of that ice pack is the subject of a fierce controversy among planetary scientists, so the prospect of reaching Europa’s surface by the next decade is an exciting one. “The risk is you send the wrong instrument or don’t find a suitable place to land,” says Jonathan Lunine, a planetary scientist at the University of Arizona, Tucson. Much will hinge on progress with the power and propulsion systems now getting under way. “You just can’t do this mission any other way,” says Ronald Greeley, a geologist at Arizona State University in Tempe who co-chaired the science definition team.

But those systems will be both costly and controversial. When it was launched, Cassini drew protests and legal challenges from environmentalists who feared that an accident could disperse radioactivity in the atmosphere. O’Keefe insists NASA will deal head-on with the nuclear concerns. “In this past year we have specifically engaged all of the public interest groups—Greenpeace, Sierra Club, Friends of the Earth—everyone out there who has an issue or an interest in this,” he says. “We’re fresh-air Freddies here; what we are going to do is very transparent.” NASA has even hired the Keystone Center, a Colorado-based public relations firm, to help its efforts.

Keystone officials did not return calls, but environmentalists are not impressed. “Keystone is not trying to address our concerns,” says Bruce Gagnon. He directs the Global Network Against Weapons and Nuclear Power. “The science you can do on Earth,” says Levy. But despite the risk, Lunine notes, “it’s not as if NASA offered us a menu.” That leaves planetary scientists with little choice but to hitch their fate to JIMO’s uncertain star. And if it works, they warn, “is making a tragic mistake [with] trouble ahead for the scientific community.”

And there is more than just Earth to worry about. NASA officials also are concerned about contaminating other parts of the solar system. “Because of radiation issues, we may have to make special provisions if the propulsion power system fails while in Europa orbit,” according to NASA documents. Such concerns are moot if the cost of JIMO and Prometheus prevents the project from reaching the launch pad. “We’re talking about missions not less than $4 billion—and we haven’t seen a commitment to sustain this,” says Levy. But despite the risk, Lunine notes, “it’s not as if NASA offered us a menu.” That leaves planetary scientists with little choice but to hitch their fate to JIMO’s uncertain star. And if it works, they should have plenty of legroom. —ANDREW LAWLER

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**NASA’s Plan for Station:**

**From Lemon to Lemonade**

NASA halts plans for a research institute and takes yet another look at which science should and should not be done on the space station

Harvard physicist David Weitz studies the behavior of soft condensed matter through experiments aboard the international space station. But President George W. Bush’s announcement this month that the orbiting lab will henceforth be devoted to science related to human missions to the moon and Mars has put him in research limbo. “If I take him at his word, then we’re all out of business,” says Weitz. “We should just pack up and go home.”

Weitz is only the latest in a long line of scientists frustrated by their involvement with the space station. In the 1980s, the facility was touted as a place where industrial and academic researchers could harness the potential of zero gravity by developing new pharmaceuticals, conducting a spectrum of basic research, and examining the effects of space on plants, animals, and humans. Construction delays and cost overruns, however, have drastically shrunk that vision. The current unfinished facility has a staff of just two who can devote only a dozen hours a week to experiments. “The science you can do on the station is largely trivial,” says Mary Jane Osborn, a biologist at the University of Connecticut Health Center in Farmington and a longtime NASA adviser on station research. “I feel both dispirited and mad.”

NASA is betting that it can transform that anemic effort into a focused, viable, and credible effort. But, as with everything involving the space station, it will take time. Last week the agency postponed for at least a year its plans to set up an independent research institute to oversee station science. The delay will allow the agency to hear from a National Research Council (NRC) study, begun in response to the president’s speech, on revamping the research program. Meanwhile, the NASA office that oversees biological and physical sciences may be reorganized, causing further delays.

But time may be running out. Bush called for a halt in U.S. station operations in 2016—far earlier than anticipated and just 6 years after completion. It is unclear how research will be done after retirement in 2010 of the shuttle fleet, which transports the large research racks that make science possible. In addition, a new crew exploration

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No glow. JIMO may face the same type of antinuclear protesters who greeted Cassini’s launch in 1997.

Water torture. Plant experiments such as this one likely will be jettisoned in the next review of space station science.
Versatility Is the Object for New Crew Vehicle

Can one vehicle really replace the shuttle, go to the moon, and take humans to Mars? NASA hopes industry comes up with the right answer

The president’s announcement that NASA hopes to establish a permanent presence on the moon by 2020 has sent engineers and scientists scrambling to figure out how to get there. It will have been almost half a century since Eugene Cernan left his footprints on lunar soil in 1972, the last astronaut to do so, and NASA no longer has a spacecraft capable of taking up where Apollo left off. Indeed, because the president wants to retire the nation’s current mode of transporting astronauts into low Earth orbit—the space shuttle fleet—in 2010, virtually all U.S. human exploration will be impossible unless NASA comes up with a safe and cost-effective vehicle that can replace the shuttle and also take payloads beyond Earth’s orbit.

NASA’s new vision will therefore be riding on efforts to build what the president called a crew exploration vehicle (CEV), to be ready to service the space station by 2014. Right now, nobody knows what it will look like, nor how it will take off and return to Earth. “They have to figure out a way to do this,” says Roger Launius, a former NASA space historian now at the Smithsonian’s National Air and Space Museum. “The complexity of any vehicle that goes beyond Earth orbit is raised immensely.”

Since the last moon landings, NASA engineers have concentrated on missions to low Earth orbit: Skylab, Apollo-Soyuz, the space shuttle, Mir, and the international space station. Indeed, until the president announced the initiative, the big U.S. aerospace firms—Lockheed Martin and Boeing—were busy designing a replacement for the shuttle known as the orbital space plane (OSP) to conduct similar missions. But the requirements for an exploration vehicle that will reach the moon are very different from those of a crew-return or crew-transfer vehi-

Cosmic companions. Future moon missions could resemble Apollo’s collection of a capsule, engine and life-support module, and lunar lander.