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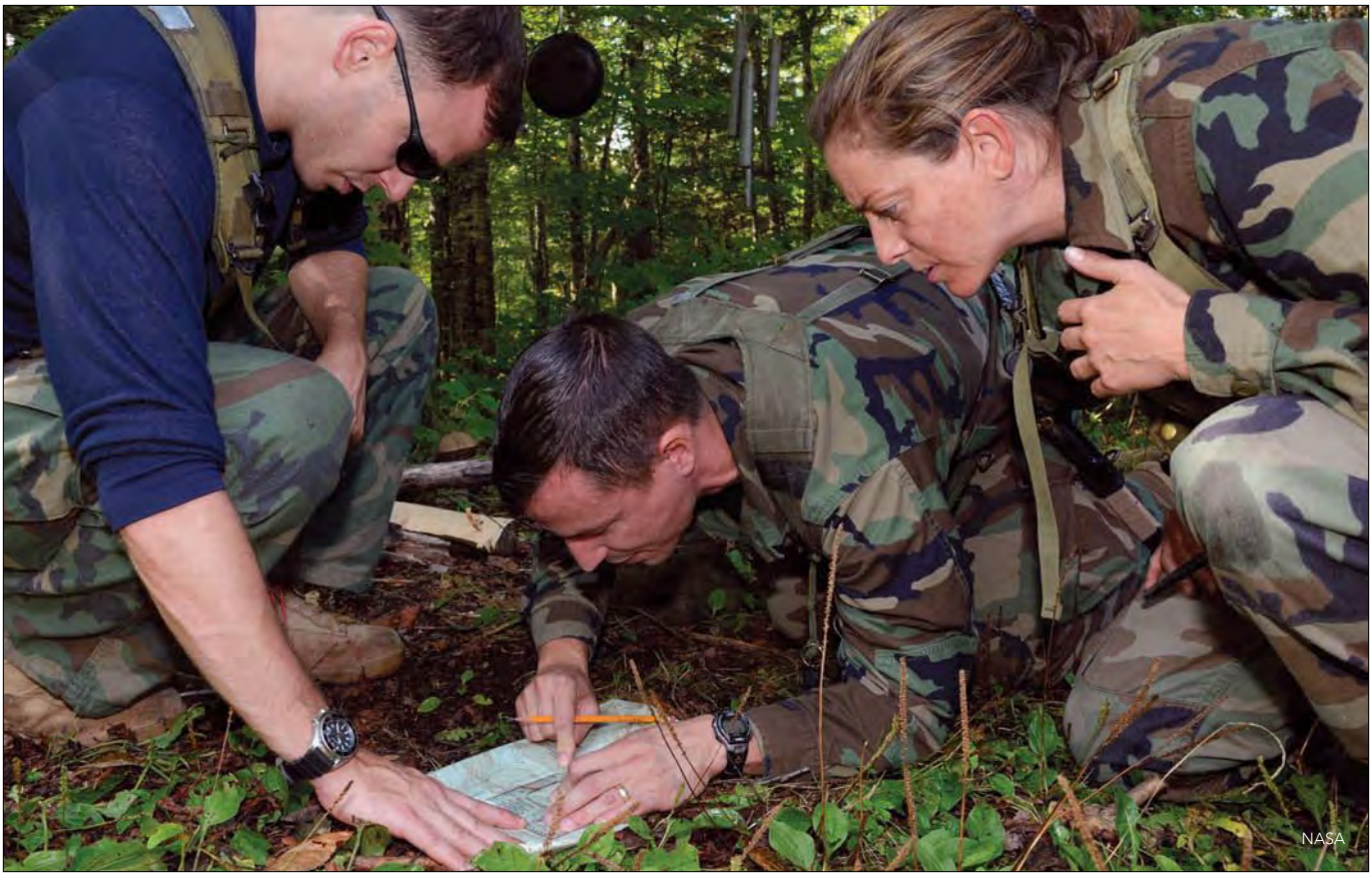
NASA's Next Astronauts

Training to become an astronaut is an honor, and the new class that NASA is in the process of selecting will enter the program at a time of ambitious plans and changes. Some of those who are selected in 2017 will be the first to fly on spacecraft built and owned by commercial companies rather than by NASA. They could also be the first humans to travel to an asteroid or Mars. Retired astronaut Tom Jones spoke to the experts about what NASA is looking for in its incoming class of space fliers.

NASA is adding new talent to its astronaut corps for the first time in four years. The agency was planning to complete its two-month call for new astronaut applicants in February and then turn to selecting its newest group of space fliers by 2017. These candidates will graduate from training two years later and will have the chance to serve on the International Space Station or travel to lunar orbit or near-Earth asteroids around 2030. A fortunate few may even embark on a multi-year journey to the Martian moons Phobos and Deimos or conceivably to Mars itself.

Those chosen to work alongside the 47 active NASA astronauts will first pay their dues on three- to six-month expeditions to the ISS, performing research, robotic operations, extravehicular activities and maintenance tasks. These assignments demand roughly 2 ½ years of intense training and travel, with long stints overseas at international partner facilities, such as Star City in Russia.

To reach the ISS, new hires must qualify as Soyuz flight engineers, and they will also train to fly aboard the SpaceX Crew Dragon and Boeing CST-100 Starliner. These commercial spacecraft are scheduled to begin flight testing in 2017 in preparation



A trio of astronaut candidates undergo land survival training in Maine in 2013. NASA has hired only 338 astronauts since 1959.

for carrying Americans into low Earth orbit through the 2020s.

A few of the newcomers will earn a mission on Orion, NASA's multi-purpose crew vehicle, venturing to the moon and beyond on the 8.8 million pounds of thrust of the Space Launch System. With NASA's current budget, Orion's first crewed flight will occur no earlier than 2021.

Between flight opportunities, astronauts are assigned to support current and future human spaceflight operations. Some will work in Mission Control as capsule communicators, or capcoms, speaking to ISS or other orbital space crews. Others will help NASA engineers solve technical and safety issues in current operations or help design, develop and test future spacecraft. All will serve as high-profile representatives of the agency through frequent public appearances and media interviews.

Astronaut candidates first undergo three years of intense training and travel, including long stints abroad at international partners facilities such as Star City in Russia. Here, astronauts Nicole Mann and Jessica Meir train for extravehicular activity at NASA's Neutral Buoyancy Laboratory in Houston.

Do you qualify?

NASA's basic hiring criteria are relatively straightforward. Candidates must possess a bachelor's degree in engineering, mathematics or in the biological, physical, or computer sciences. They must also demonstrate three years of increasingly responsible professional experience. A doctoral degree meets this three-year requirement, and teaching experience, either K-12 or in college, is also qualifying. Pilot applicants must have racked up a thousand-plus hours as pilot-in-command of a military or civilian jet.

Duane Ross, who headed the astronaut selection office at Johnson Space Center in Houston from 1978 until last year, told me that he was often asked by aspiring astronauts what they should study in school. Ross advises: "Just get the basic education that we say you have to have. You can't go take 'astronaut' in college — we'll teach you that. Just stick to the basics."

Anne E. Roemer, who succeeded Ross in 2015, says her office "is focused primarily on [hiring for] long-duration missions, with flights lasting anywhere from four [to] six months." For the final decade of planned ISS operations, NASA wants to keep a diverse skill set among its new hires, and is seeking experts in everything from hard science to medicine to engineering to test flying. For example, the eight astronauts hired in 2013 included four test pilots, a flight surgeon, a physicist/aviator, an electrical engineer and a physiologist.

Ross says the agency has not been targeting specific academic disciplines.

"We took the best players from across the board, and we got a pretty good mix of disciplines."

Roemer adds that in addition to academic excellence, an applicant's communication and social skills are highly valued.

Because the height and reach requirements for the new orbital transports like Crew Dragon, CST-100 Starliner and Orion are still fluid, NASA has retained the current Soyuz height standards for this selection: A candidate's height must be between 62 and 75 inches. U.S. crewmembers on the ISS might still fly on Soyuz even after the two commercial spacecraft come online. Although the new craft may eventually allow NASA to apply more flexible height requirements, Roemer reiterated that applicants must still be able to meet the arm reach, torso length and range of motion restrictions of NASA's current Extravehicular Mobility Unit spacesuit.

Successful applicants must pass the NASA long-duration flight physical exam. Acuity in each eye must be correctable to 20/20. Glasses are OK, and NASA has approved certain corrective surgical procedures used to improve vision, including Lasik.

The selection process

NASA in March will begin evaluating the applications received through February. NASA hasn't said how many applied, but about 6,113 applied for the last selection in 2013. An astronaut rating panel reviews the appli-

The Right Stuff
(and degree and height)

For the first time since 2011, NASA is looking to hire U.S. citizens to become astronauts. Flying experience is not necessary, and you can even wear glasses. Statistically, though, it will be harder to join the astronaut corps than to get into Harvard. Here's a look at the job requirements and features:

Applicants: More than 6,000

Number of openings: Eight to 14

Degrees and experience: Bachelor's in engineering, math or in biological, physical or computer sciences. Also need three years of professional experience, which can be met with a doctoral degree, one thousand hours as pilot-in-command of a jet or three years as a teacher, for example.

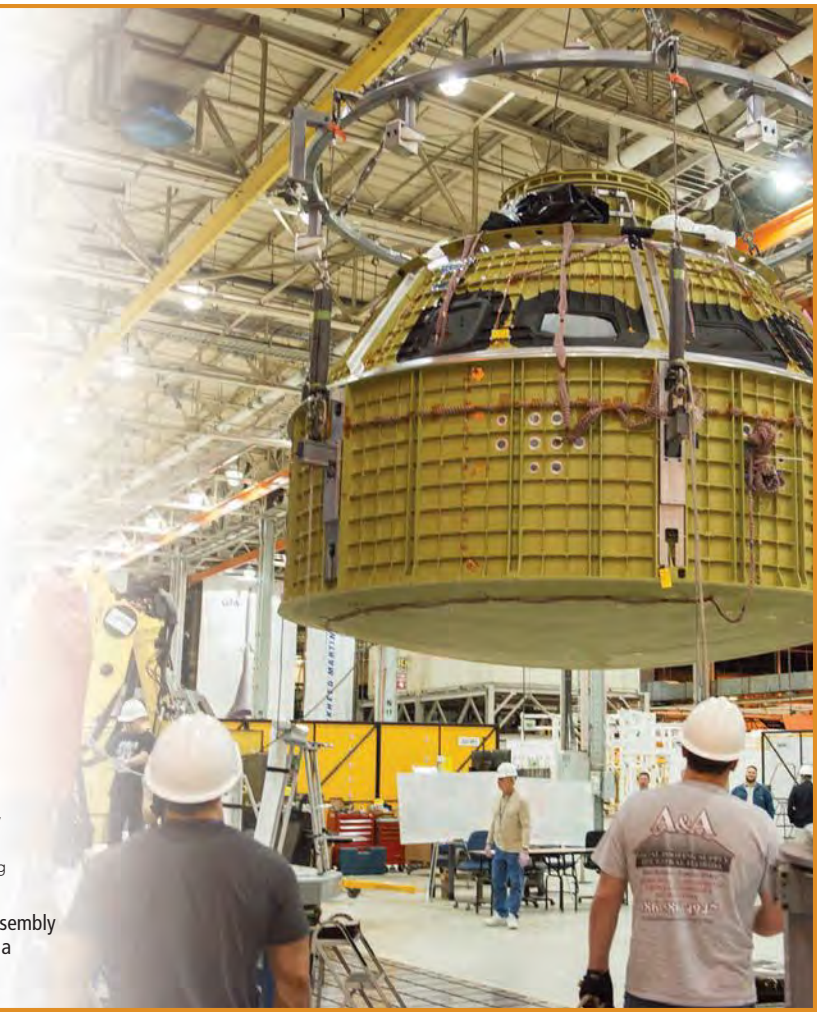
Age: Open to all

Height: 5 feet 2 inches to 6 feet 3 inches

Salary: U.S. government General Schedule 11 to 14, based on experience. GS-11 for 2016 starts at $66,893 (including a Houston locality adjustment), and GS-14 tops out at $146,468.

Flight rate: First spaceflight about five years after hiring, with another flight about every five years.

Sources: NASA; Aerospace America reporting



An Orion crew capsule undergoes welding at NASA's Michoud Assembly Facility near New Orleans. Astronauts selected next year may get a chance to fly in Orion.

cants' academic and work experience and sorts their packets into "qualified" or "highly qualified" categories. Based on their records and outside references, the agency invites 120 of the best qualified applicants for a week-long evaluation at Johnson Space Center. Arriving in groups of 20, the applicants receive a job orientation, a preliminary medical exam, a facilities tour and opportunities to meet and question working astronauts. The applicants are also challenged with a half-day, hands-on outdoor leadership exercise, a chance for the selection team to see how aspirants handle some team problem solving.

The highlight — and the most intimidating — event of each applicant's week is an hour-long interview with the Astronaut Selection Board. Ross has participated in thousands of these make-or-break sessions. He says the board "doesn't have standardized interview questions … We start with, 'Take us back to high school, tell us what you did, and bring us up to speed with today.' Then we'll ask questions along the way, getting at all the things we need to ask, like teamwork and outside activities. We're looking at the whole person, and that's what we get from asking about their outside activities."

The most promising 50 or 60 applicants will be invited back to Houston for a second interview with the board and for the more extensive long-duration flight physical. The finalists identified by this second round of evaluation form the pool from which NASA officials will pick the new hires.

How does the board choose the top applicants? Looking back on his interactions with many boards over the years, Ross says, "You're never going to have a unanimous vote; you go in understanding that."

He always emphasized to board members that "If there's anybody you have a 100 percent problem with, that's what we need to know." Ross adds, "The important thing is not to try to find the best person, but not to get a bad one, and be sure everyone you pick can do the job."

For almost 40 years, this "fail safe" approach has produced astronauts who almost universally met the needs of management, flight directors and fellow crewmembers.

Astronaut school

The agency will announce its new astronaut candidates in about a year. Roemer says NASA hopes to beat that deadline, depending on the number of applications received. The new class will report for work in the second half of 2017.

Astronaut candidates must complete a two-year training program designed to school them in human spaceflight operations at the ISS and on the various orbital transport vehicles. They'll be evaluated on their mastery of station systems, spacewalking skills, their performance as a crewmember in NASA's T-38N Talon jets and proficiency in Russian. Completing the course earns them a silver, astronaut-corps lapel pin and makes them eligibility for a spaceflight assignment.

The tradition is that all qualified crewmembers receive a chance to fly in space, but NASA makes no guarantees. When my Group 13 class, "The Hairballs," arrived in July 1990, the first member of our group launched on a shuttle about 2 ½ years later. With today's slower launch pace, it's likely that the 2017 group will wait nearly five years before the first makes it to orbit.

For deep space, stay the course

Duane Ross says that over four decades the agency has honed the selection process to a keen edge.

"Every time we did a selection and every time we flew a mission, we got a little smarter about what the requirements were. But from 1978 up 'til 2013 [the last cycle Ross ran], the process and the requirements we were looking for basically stayed the same. You want somebody with the required education, obviously, and just good, hands-on operational skills."

NASA has never claimed the selection process is perfect (I got in, after all), but Ross says management has been "pretty happy with the folks we produced. The process took care of itself in terms of its credibility and the kind of people [chosen]. The board had a vested interest in finding good people because that's who they were going to have to work with and depend on."

Reflecting on his years spent selecting astronauts, Ross says "It's a heck of a lot of work but it's also really fun … I don't think there's any reason to look for anything different [this time] over past selections." No matter the spacecraft, he says, "You gotta fly 'em, and you have to know all the stuff you had to know all along."

Simply put, an astronaut's job is the best on the planet. In my latest book, "Ask the Astronaut," I hope to inform and inspire a few more aspiring space fliers. To all the applicants: Good luck!

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