Welcome to Your Home on Mars

Never mind how to get there—what will we live in on the Red Planet? Personal Tech columnist David Pierce examines designs from Bjarke Ingels, Foster + Partners and others.

By David Pierce
April 9, 2019 11:00 am ET

Mars has a lot going for it, habitability-wise. Many big challenges remain, of course, but scientists believe there's plenty of potentially usable water, and an atmosphere close enough to our own to ultimately sustain life—with the right gear.

Unfortunately, that's not all humans would need to function on a new planet. They'd want to watch "The Bachelor" and play videogames, and they don't tend to like being cooped up in the dark. When you send humans to Mars, you have to deal with a set of decidedly human problems.

Over the last few years, while scientists have been working on the technology required to get humans to the Red Planet, architects have been turning their minds to what daily life might be like there. Many of their ideas have entered a NASA-sponsored contest called the 3D-Printed Habitat Challenge, which solicits designs for Martian habitats.

Behind the contest is the idea that NASA would build structures on Mars using a 3-D printer—the agency would send a cargo ship ahead of the humans, carrying a printer programmed with blueprints. As soon as it landed, the printer would create construction material out of the regolith—the dust, rock and various other junk on top of the surface—to start building homes.

These NASA competitors and others are scheming and prototyping, going to the far reaches of the Earth to try to understand what life might be like off it. They don't treat Mars as a science experiment or a place for astronauts to land, plant a flag and head home. Rather, they see the

planet as the next outpost of the human race, a way to keep our species alive even in the event of Earth's extinction. And they want to help make it feel like home. Here's a look at some designs—including some submitted to the NASA competition and others outside of it.

THE MODULAR MODEL

The habitat designed by Team Zopherus would be made of three hexagonal structures. **ILLUSTRATION:** TEAM ZOPHERUS

Team Zopherus in Rogers, Ark., led by architect Trey Lane, imagines a habitat containing three hexagonal structures. The center is the living space: You come through the airlock into the common area, where there's a large window that provides sunlight both to people and to a hydroponic garden that grows plants and herbs. Off to one side is a second building, housing a laboratory. The third building is the crew's space, where each person has a small private bedroom and viewport to the outside—it looks a bit like a cruise ship bedroom.

Mr. Lane said psychological comfort was as important a consideration as simple survival. "We wanted to make sure the astronauts had an area that was private, that was their own personal space," he said. Many things have double purposes: the storage space in the ceiling also acts as a radiation shield, for instance, and the small hydroponic garden produces both pleasing greenery and oxygen. Composting toilets, another staple of most Martian home designs, get a private area of their own.

COOLEST FEATURE: Each building has room for a small airtight hatch that leads to the outside, and adding more space is as simple as printing another hexagonal shell and attaching it to an available hatch.

THE SKYSCRAPER

With the "Marsha" plan, AI SpaceFactory, a technology-focused architecture firm located in New York, envisions life in a large multilevel cylindrical building (at top). It's made of two shells: an exterior wall that acts as a shield against the elements, and an interior space for humans.

An interior of AI SpaceFactory's design. **ILLUSTRATION:** AI SPACEFACTORY

The internal area comprises four levels, connected by a long spiral staircase. The ground level, called the garage, is where astronauts and rovers come and go, and where lab work happens. Up a level is another lab, along with the kitchen and the main communal space. Above that are private bedrooms and a garden. On the top floor, beneath a large skylight, astronauts would have a place for exercise and relaxing.

AI SpaceFactory wants the structure to feel as Earth-like as possible. The space between the two shells helps diffuse light across the habitable space, while each shell has its own air and temperature regulation.

COOLEST FEATURE: Marsha has an internal, regulated lighting system that recreates Earth-like light, helping to keep the crew on a normal circadian schedule.

THE GIANT DOME

Architect Bjarke Ingels and his firm are working with the government of the United Arab Emirates to build what they call Mars Science City in the Emirati desert. **ILLUSTRATION:** BIG-BJARKE INGELS GROUP

Rather than test its designs in a competition, architect Bjarke Ingels and his firm are heading to the desert outside of Dubai. Working with the government of the United Arab Emirates, they plan to build what they call Mars Science City in the Emirati desert, which has soil and weather more like Mars than almost anywhere on Earth. They've designed a community with 1.9 million square feet of space that can test what it might be like to build, settle and live on Mars.

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"The biggest obstacle to Martian colonization is radiation. Not only will any spacecraft sent to Mars be bombarded with high energy radiation for 6 months but, because the Martian atmosphere is so thin and its magnetosphere is so weak, people who make it there would have to live several meters underground until ways are figured out to build above ground structures with sufficient

The city starts with several large, overlapping pressurized "biospheres" that can be tied to the ground and inflated. Inside them, robot machinery can look for water, regolith and more. They would use the local material, simultaneously digging down and building up, to create multilayer buildings, which also act as a progressive shield against radiation—the safest space will be the bottom floors, underground. Education and work would largely happen below the surface, while agriculture and housing would be above-ground. (Digging out a home is more work than building one, and humans might find underground housing depressing.) Most of the core buildings and infrastructure would be 3D-printed, but there's plenty of space for additional construction within the enormous domes.

Mars Science City would be made up of several large, overlapping pressurized 'biospheres.' **ILLUSTRATION:** BIG-BJARKE INGELS GROUP

Rather than focusing on small individual habitats, Science City opens everything up—with lush foliage indoors and open space, it wouldn't feel so much like living in an Airstream. Science City is meant as an educational tool, and will house a space museum, but also acts as a place to research everything from food to construction in a Martian-like setting. When it's ready, a team will live in the domes for a year, trying to learn what it might be like to live on the Red Planet.

COOLEST FEATURE: The team ultimately wants to create even larger structures, building super-strong donut-shaped domes called "toruses" that, when combined, could allow for more than a million people to live in a single community. Some scientists believe the torus is the shape of the universe, which is pretty good inspiration.

THE INFLATABLE CITY

A design from architecture firm Foster + Partners. **ILLUSTRATION:** FOSTER + PARTNERS

Architecture firm Foster + Partners designed a system in which small pre-made modules would be installed inside a large 3D-printed anti-radiation barrier on Mars' surface. The modules would then be inflated and connected with airlock tunnels. The whole setup has a kind of glamping vibe, like a yurt designed by a sci-fi author. Inside, it's all white walls and transparent touch screens next to hydroponic gardens.

Like many others, the team focused on keeping the Martian radiation and meteorites out. Rather than protect each building individually, they imagined a massive wall, constructed out of local Martian soil, designed to protect entire communities from the sun's radiation. (Think the Wall from "Game of Thrones," but meant for keeping out sun instead of undead monsters.)

Foster + Partners identified one particularly tricky material to keep out: dust. Sandstorms can destroy machinery, and even dust tracked into a habitat can cause problems. So the team designed a system it called "Suitports," in which spacesuits are sealed to the outside of the habitat, and astronauts climb into them from the inside like they're entering a vehicle. That way everything that's exposed to Mars stays outside.

COOLEST FEATURE: The firm designed everything with redundancy in mind. The giant wall would be built by swarms of robot-printers rather than a single device, and the modules can be swapped in and out if something goes wrong. And in space, something always goes wrong.

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