

**Web links**

- <http://www.synthesis-intl.com> Adams company with innovative design
- [http://nssdc.gsfc.nasa.gov/planetary/mars/mars\\_crew.html](http://nssdc.gsfc.nasa.gov/planetary/mars/mars_crew.html) scientists to mars
- <http://cmex.ihmc.us/CMEX/index> [http://www.marsnews.com/missions/humans\\_to\\_mars/](http://www.marsnews.com/missions/humans_to_mars/) .html resources on mars
- <http://www.solarviews.com/eng/mars.htm>
- <http://www.hq.nasa.gov/osf/> nasa site on the future
- <http://nasajobs.nasa.gov/astronauts/> how to become an astronaut
- <http://www.seti.org/site/pp.asp?c=ktJ2J9MMIsE&b=178025>
- [http://www-k12.atmos.washington.edu/k12/mars/mars\\_resources.html](http://www-k12.atmos.washington.edu/k12/mars/mars_resources.html) kids mars links
- [http://en.wikipedia.org/wiki/List\\_of\\_manned\\_spacecraft](http://en.wikipedia.org/wiki/List_of_manned_spacecraft) list of manned space flight
- <http://spaceflight.nasa.gov/home/index.html> manned space flight
- <http://www.spacearchitect.org/>
- <http://www.realspacemodels.com/>
- <http://www.spaceref.com/>
- <http://earth.jsc.nasa.gov/sseop/efs/>
- [http://www.nasa.gov/mission\\_pages/exploration/main/index.html](http://www.nasa.gov/mission_pages/exploration/main/index.html) nasas vision for space exploration

**Books magazines**

- <http://www.airspacemag.com/> Air and Space Magazine Smithsonian
- <http://www.cnn.com/TECH/space/index.html> CNN space page
- <http://www.cosmo.org/> Kansas Space Museum

audio pod cast [http://www.metropolismag.com/AUDIO\\_files/1885/met\\_1885\\_a3.mp3](http://www.metropolismag.com/AUDIO_files/1885/met_1885_a3.mp3)

Settling Mars and other worlds beyond Earth may be essential to the survival of humanity. (credit:



Ginger Head, Executive Director  
[www.icfw.org](http://www.icfw.org)  
[imagine@icfw.org](mailto:imagine@icfw.org)



Milbry Polk, Director  
[www.wingsworldquest.org](http://www.wingsworldquest.org)



# The Art of Exploration

EXTRAORDINARY EXPLORERS AND CREATORS INSPIRE US ALL TO REACH OUR OWN POTENTIAL



**CONSTANCE ADAMS**  
 SPACE ARCHITECT

Space exploration is the physical exploration of outer space beyond earth. Space exploration propels scientific research and is focused on the future survival of humanity.

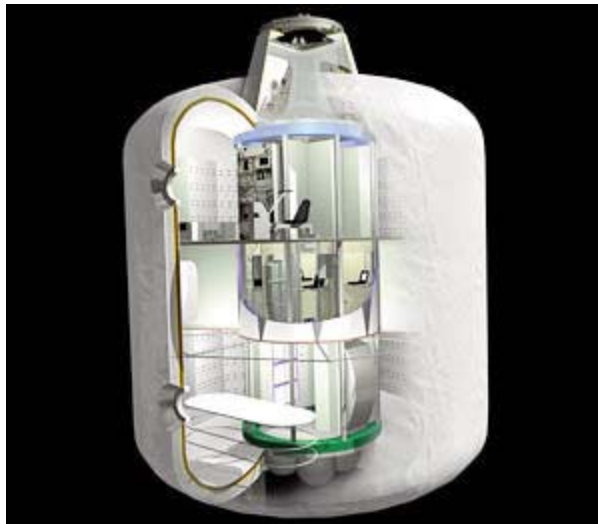
Constance Adams was born in Boston, Massachusetts. After graduating from Harvard '87, and the Yale School of Architecture '90 Adams lived in Tokyo designing skyscrapers and then moved to Germany to join the team redesigning Berlin. Seeking new challenges she joined the Lockheed Martin Space Operations Company, in Houston, Texas as a Space Architect and Human Factors Engineer. She was part of the team that designed and built the modules that will transport astronauts to Mars called TransHab and the module where they will live and work on Mars called BIO-Plex. At the time she joined NASA it was believed that the first interplanetary human explorers would be launched to Mars within the next two decades. She founded a design firm, Synthesis International, which is working on other innovative space and terrestrial designs. She speaks seven languages, French - German Spanish Latin Italian and Japanese.

When Constance Adams began learning the fundamentals of architecture, engineering, and design, she never dreamed she would one day apply them to a habitat designed for the surface of Mars. That project is one of many she has undertaken for NASA as a space architect.

Focusing on safety, livability, and other human factors, Adams has also created designs for the next-generation NASA space shuttle, the TransHab prototype spacecraft for planetary exploration, a crew-return vehicle, and heat shields for reusable spacecraft.

Adams embraces the theory of biomimetic architecture, in which architects and engineers examine biological and botanical life for ideas that can be applied to structural design. "I believe that the model for every requirement we have is already solved somewhere in nature. I've learned just exactly how perfectly our planet is designed to support life.





### WHY IS GOING TO MARS IMPORTANT?

The best answer I can think of is that the experience will allow us to ask the questions we don't now know to ask. We all have so much to gain from the discoveries and developments that are being created for Mars.

### HOW CAN WE PREPARE TO GO TO MARS?

The explorers who go will be some of the most creative, open-minded, adaptable, individuals who are technically competent in a number of fields. We want people who will not fall apart in the face extraordinary situations.

One of the great worries concerns the trip out. When the Earth becomes smaller and is finally lost to sight is something that no human being has ever faced. I have debriefed many astronauts and all have

described in spiritual terms what being able to see the Earth has meant to them. It consoles them. So the effects of losing the Earth is something we can't envision. Losing the earth is going to be hard.

Another aspect to consider is that the people going are ones that really want to see Mars. They have the courage and love to go and embrace this experience. Those people will have a real hard time coming home. Not only will they have had an extraordinary experience that will be hard to relate but they know they will never be able to go back. They will never see it again. Their bodies will have absorbed so much radiation and deteriorated so badly. I would love to but I am too old and I have a heart condition. The best thing I can hope for is to be able to train the person who will replace me. I want to educate people about the importance of continuing this mission.

### HOW DID YOU BECOME A SPACE ARCHITECT?

Well it is a unique job! Many people have asked me how I studied to become a space architect. And I tell them that my basic preparation was in liberal arts. After I graduated from Yale School of Architecture I worked on urban design projects abroad. I was in Tokyo designing skyscrapers in Asia and then I went to help rebuild Berlin after the Wall came down. In '95 I came back to the States to find a new challenge. While I was interviewing in Houston I decided to go see NASA. While taking the tour of the facility I was struck by how unique NASA is. It is a brain trust. When I met with the Mars mission people at first I thought they were crazy to want to go to Mars. Then I realized rebuilding Berlin was nothing in comparison. So I applied for a job and found myself in one of the most amazing projects ever undertaken.

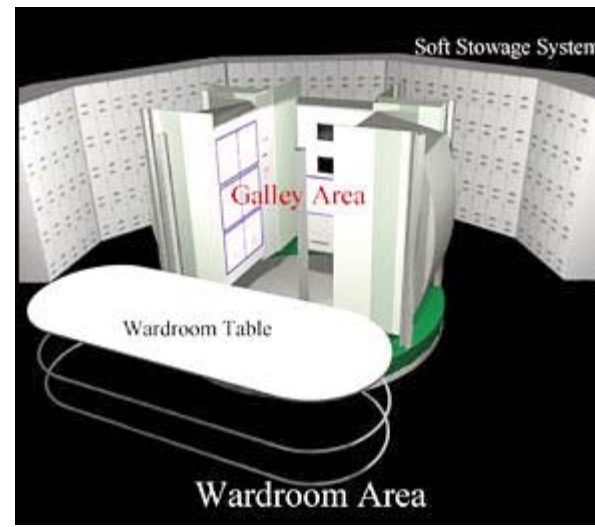
### WHAT DOES A SPACE ARCHITECT DO? WHAT ARE YOU DESIGNING?

Space design is not about an idea or a style but rather is a matter of life and death. The engineers drive this project. So a big challenge for me is to understand what they are trying to do so I can create the design that effectively incorporates their work. Also I have to think about what the crew needs and wants to do and figure out how the design can make it easier for them to accomplish their goals. I realized we needed to stop looking at old programs and patching things together and design something totally new.

I have been working on two projects

TransHab is the vehicle that will take the space explorers from the Space Station to Mars and remain in orbit around Mars then return them to the Space Station. It will be in use some 800 days – the estimated duration of the Mars mission. The Mars Reference Mission calls for 180 days transit, about 450 days on Mars, and 180 days return transit.

BIO-Plex is the least known and probably NASA's most important undertaking. It is the creation of a complete eco system, which will enable humans to live on Mars. We have built and were testing this prototype surface habitat for Mars. We had plants for food and for oxygen supply. We had achieved 95% on water recovery and waste reuse and were aiming 100% oxygen recovery. We can grow 80% of the food using waste processed by bacteria and put back into growing food.



I began by debriefing astronauts from Mir and the Space Station to find out what worked for them and what they would like to see in a new space craft.

I found it is important for them to maintain a sense of the vertical -- a sense of up and down, a sense of floor. Even people who have been in orbit for six months can lose their way in a module that is not specifically designed to help cue their sense of direction. I have designed patterns that can be woven into the wall fabric that suggested up and down. And that there is a structural element every 6 to 7 feet so they can propel themselves around.

People will be inside the transhab for several years so we had to create a design for long term living. There is a separate place for exercise, medical facilities, sleep, and a place for everyone to sit together.

We found that it is really important for the whole team to be together for an hour every day to discuss the plans for that day. Sitting down face to face everyday is critical to keep tensions from building to a problematic level. There is also space for the crew to watch movies together or have a birthday party. I try to always work things out to reduce potential areas of friction – so for example someone passing through doesn't bump into you or pass over you. If this happens over and over it can lead to problems.

The design of the space craft is very new also. Until now all spacecraft has been exoskeletal. You are protected in a solid but constrained shell. THE TransHab is endoskeletal. It has an optimized pressure shell. It is lighter and much more efficient. The shell's outer protective layer is made of a new type of technology which is layers of glass fabric like kevlar, called Nextel, separated by inches of foam. This covering is able to absorb any kind of projectile. TransHab is very, very safe.

### HOW DOES TRANSHAB GET INTO SPACE?

It is broken down into components and needs to fit into the payload of the space shuttle – a size actually determined by the maximum cargo capacity of the Federal rail and highway system (which one hears is derived from the width of two horses side by side -- a Roman measurement). When it is reassembled on the space station it has everything built in already even the light switches. Like getting your house broken down wall by wall and delivered in a truck to the building site, and then unpacked and reassembled.

### HOW DOES TRANSHAB FLY TO MARS?

We can attach a propulsion package to TransHab. Other people are working on developing solutions for that now. It needs a lot of fuel to get there and back so the methane collected on surface of Mars is vital for the return journey.

### HOW WILL THE BIO-PLEX BE SET UP ON THE SURFACE OF MARS?

The plan is to send robotic missions a few years in advance of the human mission to set up the BIO-Plex (or surface habitat) environment. The first goal of the robotic mission is to break down the Martian atmosphere into elemental components to create a supply of water, oxygen and methane fuel that can be used when the astronauts arrive.

### WHAT ARE THE RISKS OF GOING TO MARS?

Risk is a big issue. The explorers personally have to accept a high level of risk. One of the main problems is that nobody can go out and rescue you. There will probably not be a second TransHab ready to go; but even if there were, it would be too late anyway. It is a six month trip. This is another reason the early delivery of BIO-Plex is so important. Mars may be the next best place where the explorers can stay for an indefinite period if the mission should somehow go wrong.

