Learning A–Z	level **Z2**	Multi-level	**Z** **Z1** **Z2**
Grade	5+	Word Count	2,083
Lexile	1150L	Nonfiction • Informational	

Refer to the Focus Question on page 2 of this title to guide discussion and support additional learning connected to the text.

Have you ever dreamed of traveling to space? That dream is now accessible to more people than it's ever been. **Private Spaceships** describes the recent shift toward a new era of private space flight. The book can also be used to teach students how to determine an author's purpose for writing and the proper use of adjectives. The book is also available for levels Z and Z1.

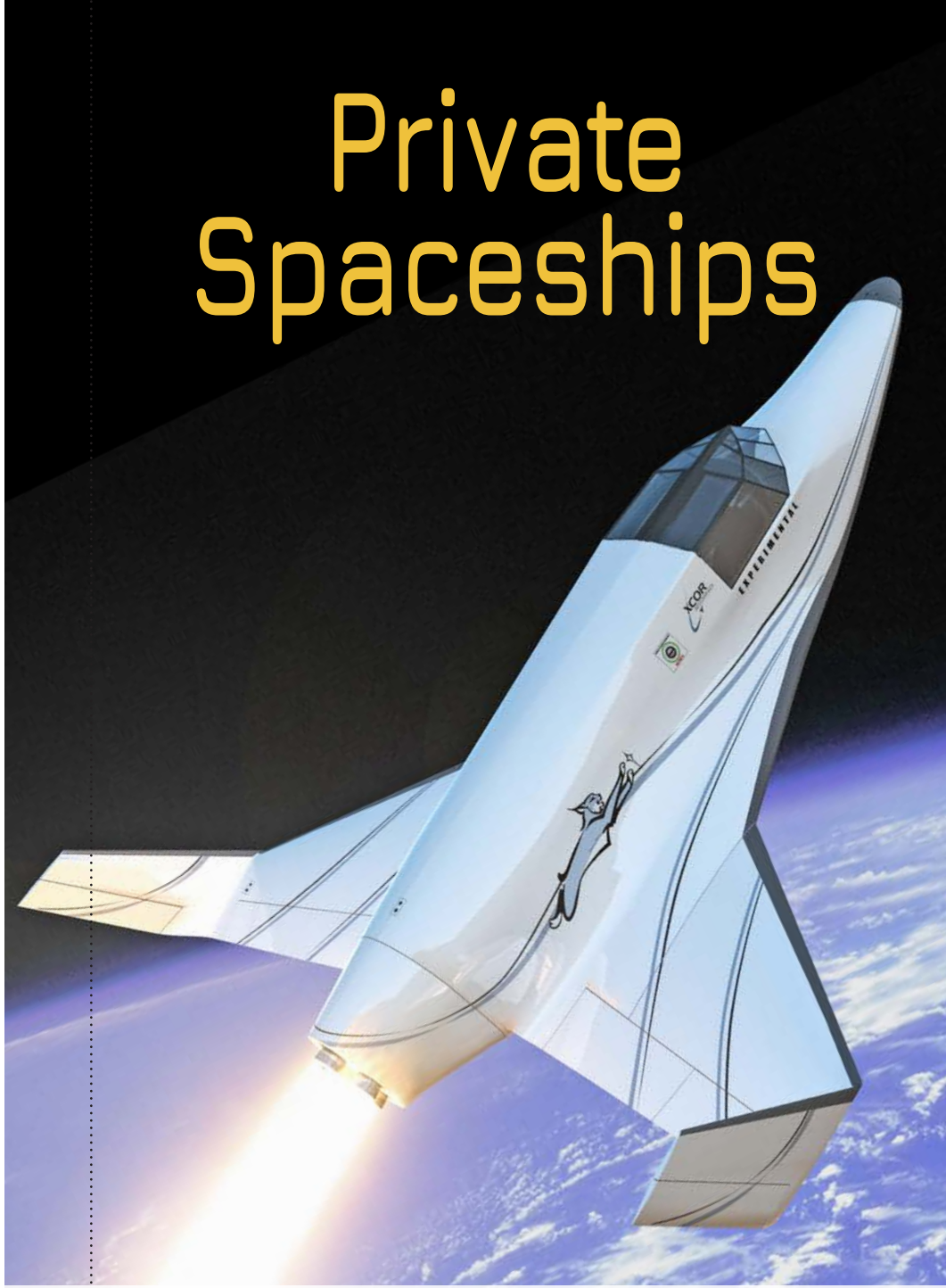
Photo Credits:
Front cover: © GABRIEL BOUYS/AFP/Getty Images; title page: © AP Images; pages 3, 20: courtesy of NASA/Ken Ulbrich; pages 4, 5, 6, 8 (top right, bottom right), 12 (main), 15, 18, 19: courtesy of NASA; page 7: courtesy of NASA/JPL-Caltech; page 8 (left): © Vitaly Yamzin/Dreamstime.com; page 10: © Scaled Composites/Science Source; page 11: © UPI Photo/HO/Landov; page 12 (background): © iStock/vlynder; page 14: © REUTERS/Chip East; page 16: © SpaceX DPA/Landov; page 17: © REUTERS/Scott Audette; page 21: © Tatsuo Nakajima/Yomiuri Shimbun/AP Images; page 23: courtesy of NASA/Bill Ingalls

Learning A–Z

For more great books visit
www.learninga-z.com

© Learning A–Z, all rights reserved.

Private Spaceships



Written by Amy S. Hansen

Glossary

aeronautics *(n.)* page 7
the science or practice of flight

capsule *(n.)* page 16
the detachable compartment on a spacecraft that holds people and their instruments

commercial *(adj.)* page 7
relating to buying and selling

docking *(n.)* page 16
the connecting of two vehicles in space

entrepreneurs *(n.)* page 9
people who start and operate their own businesses

forerunner *(n.)* page 12
one that comes before and is followed by others

inflatable *(adj.)* page 22
able to be filled with a gas, such as air

mission *(n.)* page 4
a set purpose for doing something; a special task or assignment

orbit *(n.)* page 5
the path taken by one object in space circling around another larger object

re-entry *(n.)* page 14
the act of returning to Earth's atmosphere from space

robotic *(adj.)* page 7
of or related to a device that is programmed to perform tasks

spacecraft *(n.)* page 5
a vehicle used for traveling in space

Private Spaceships

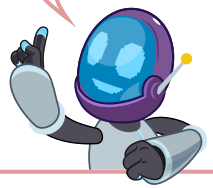
Above: Pilot Michael W. Melvill celebrates after landing SpaceShipOne following a suborbital flight to space on June 21, 2009.

Cover: XCOR Aerospace is building the Lynx suborbital spaceplane to carry passengers safely to the edge of space and back.

Written by Amy S. Hansen

Focus Question

How and why has space travel evolved?



Words to Know

aeronautics	inflatable
capsule	mission
commercial	orbit
docking	re-entry
entrepreneurs	robotic
forerunner	spacecraft

Connections

Writing

Research to learn more about NASA. Write an essay including facts from the book and other resources. Include a timeline of at least five of the most important milestones in NASA's history.

Science

Research the topic of weightlessness during space travel. Describe why it happens and what short-term and long-term effects it has on astronauts.

Life-sized models of Bigelow Aerospace's inflatable space habitats.

Conclusion

The final flight of the space shuttle marked the end of one era in space, but it also signaled the beginning of an exciting new age of commercial spaceflight. Private companies around the world are working hard to bring their spacecraft designs from the drawing board to the real world. Soon, private spaceships will be doing many of the tasks that previously only government space agencies could do. Companies will provide many new options for sending cargo and people into space and for staying in orbit for extended periods of time. Are you ready for the commercial space age?

Private Space Stations

Flights on vehicles such as *SpaceShipTwo* will allow tourists to experience weightlessness in space for several minutes, but what if you wanted to see what it's like to stay in space for weeks or even months at a time? At least one company—Bigelow Aerospace—is working to make space hotels a reality. Bigelow is creating a "balloon habitat." The habitat folds up into a rocket's cargo area and expands when it is placed into orbit. The company is working on a unit that will house six people in a space similar in size to the ISS.

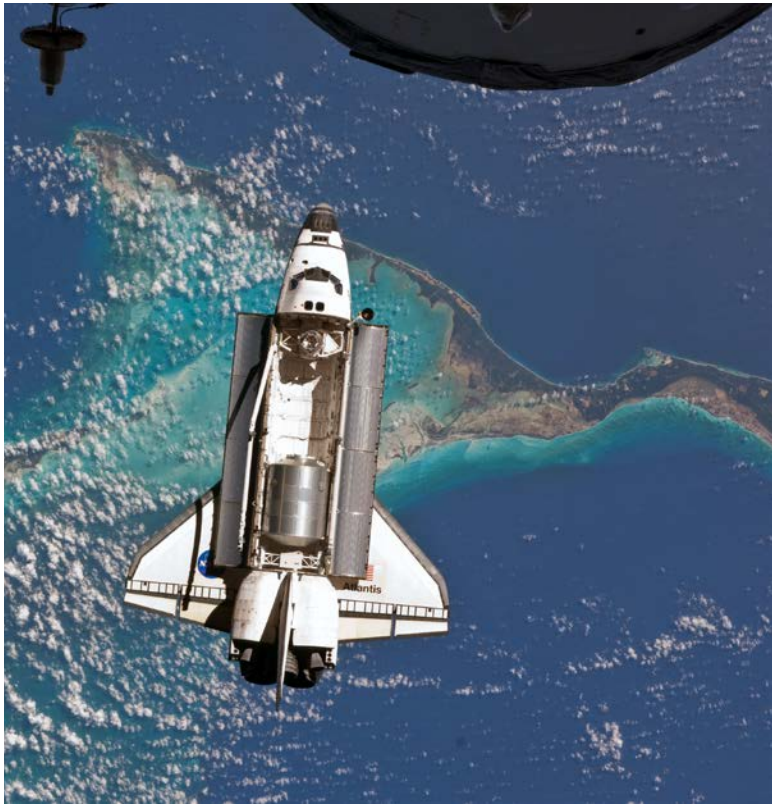
The skin of the Bigelow habitat is made of a strong fabric called *Mylar*. Building a space station out of fabric may seem strange, but Bigelow engineers say that the fabric will actually work better than metal. NASA thinks these habitats are safe, too; the space agency is looking at buying one to expand the ISS.

While these blow-up habitats aren't ready yet, Bigelow sent two empty test models into space in 2006 and 2007. If things go according to plan, future **inflatable** habitats will be launched and assembled into the world's first private space station.

The Dream Chaser spaceplane was designed to resupply the International Space Station.

Table of Contents

The End of an Era 4
The Dawn of a New Era 8
A Second Space Race. 10
Ticket to Ride 12
Space Delivery Service 15
People Movers 18
Private Space Stations 22
Conclusion 23
Glossary 24



The shuttle *Atlantis* prepares to dock with the International Space Station on July 10, 2011, during the final mission of the space shuttle program.

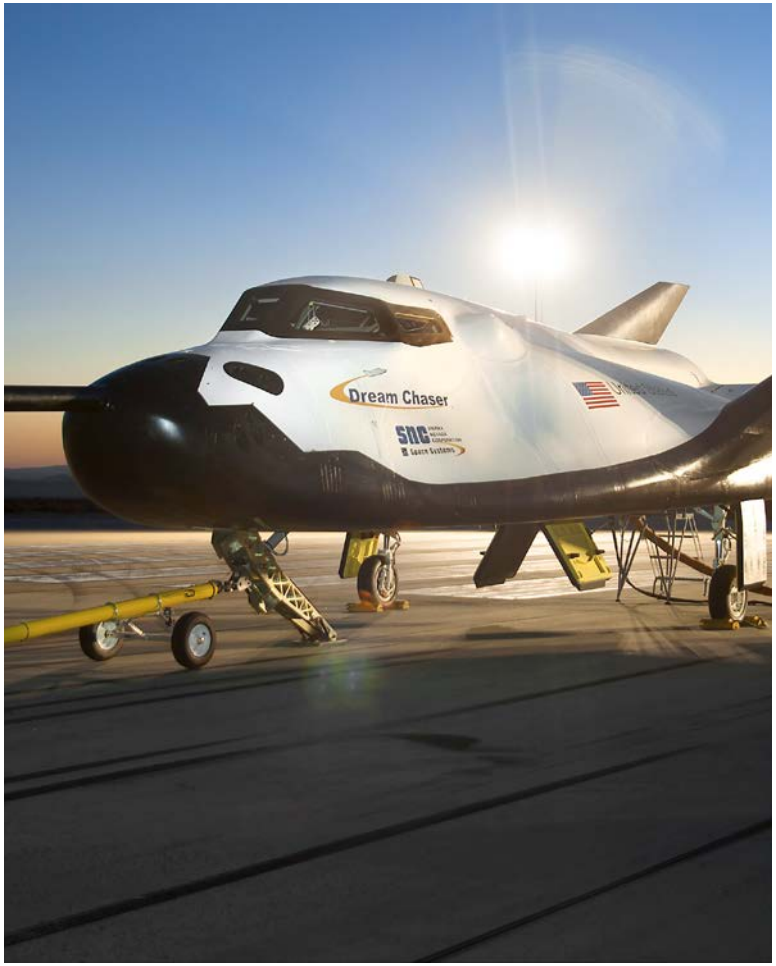
The End of an Era

In the early morning darkness on July 21, 2011, the space shuttle *Atlantis* touched down at the Kennedy Space Center in Florida after spending twelve days in space. It was the 135th time a space shuttle had flown a **mission** since the shuttles began flying in 1981. It was also the last time a NASA space shuttle would make a journey into space.

Boeing's Crew Space Transportation (CST-100) spacecraft, which will take astronauts to the ISS, was unveiled in 2013.

NASA judged the early spaceship designs and awarded money to four companies to develop their plans. A company called Sierra Nevada proposed a space glider called the *Dream Chaser*, which looks like a smaller version of NASA's space shuttle. The *Dream Chaser* is designed to travel to space on top of a rocket but glide back down to Earth.

SpaceX created a crewed version of its Dragon capsule for moving people back and forth to space stations. Two other companies, Boeing and Blue Origin, also designed capsules that would go up on a rocket and splash down into the ocean at the end of the mission.



The *Dream Chaser*, built by SpaceDev, is designed to carry seven people back and forth to the ISS.

In 2010, NASA asked commercial companies to design spacecraft to move people back and forth to space stations. These ships would need to be able to carry seven astronauts to the ISS and then remain docked for up to 210 days before flying back to Earth and landing safely.

The space shuttle was the world's first reusable **spacecraft**. *Columbia, Challenger, Discovery, Atlantis,* and *Endeavour*—for thirty years space shuttles were the focus of the space program in the United States. The shuttles carried people and scientific experiments into Earth's **orbit**; launched, recovered, and repaired satellites; and helped assemble the largest structure in space, the International Space Station (ISS). Once *Atlantis* touched down, however, these spacecraft would only be seen on display in museums.

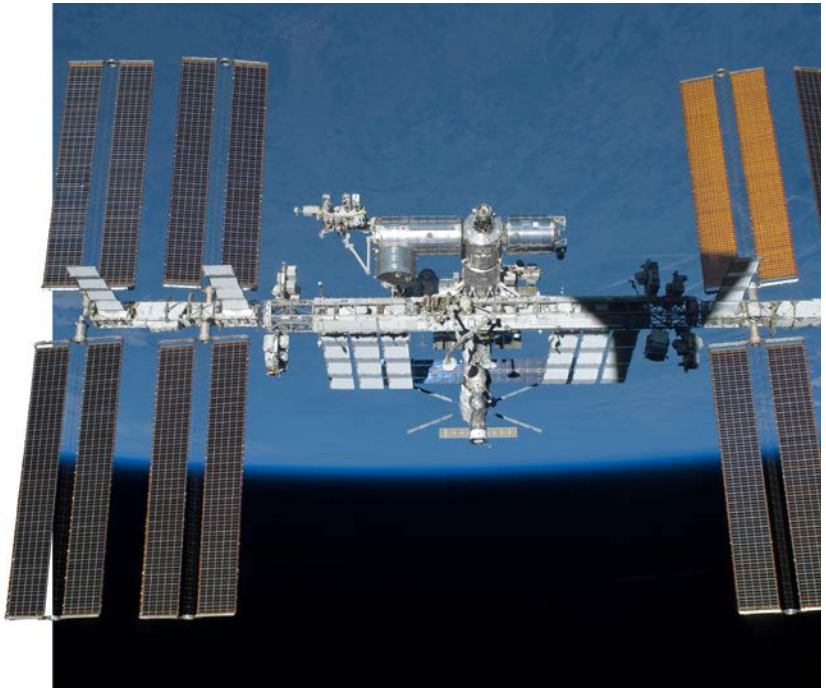
Space shuttle launches were impressive spectacles that drew huge crowds.

Three NASA astronauts grab a malfunctioning satellite during a spacewalk outside the space shuttle *Endeavour* on May 7, 1992.

By 2011, the space shuttles were getting old, but that wasn't the only reason they were retired. They were also expensive to launch and difficult to maintain. The shuttles could be used to do some amazing things that no other spacecraft could do, such as grabbing satellites from orbit and returning them safely to Earth. Experience had shown, however, that using the space shuttles for simpler tasks such as launching satellites or delivering people and supplies to the ISS was too expensive for NASA to continue.

The International Space Station is the largest space station that has ever been built. It was created with the help of many nations at a cost of billions of dollars. The ISS is almost exactly the size of a football field. It is so large that it can be seen at night from Earth with the naked eye.

Since it was first crewed on November 2, 2000, the ISS has never been empty. Over two hundred people from fifteen nations have visited the space station. Moving people safely back and forth from space stations, such as the ISS, is an important job.



The ISS is powered by large solar panels. More than 8 miles (12.9 km) of wire connect the power system.

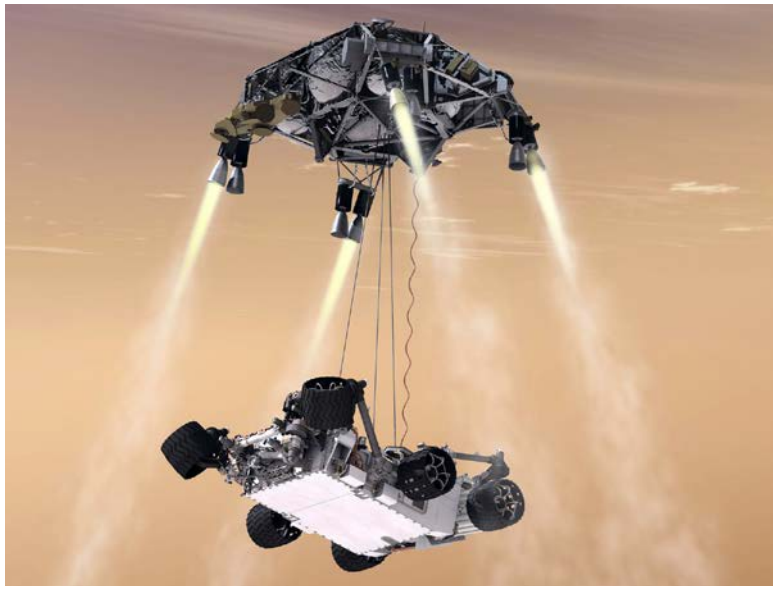
An artist's drawing shows how the space shuttle *Atlantis* docked with the Russian *Mir* space station in 1995.

People Movers

Space stations are spacecraft that are placed in long-term orbits around Earth. Modern space stations are often put together from many separate, smaller pieces, each of which can be sent up one at a time from Earth. Once a space station is completed, crews can come on board to work and live, and other spaceships can dock there.

Scientists use space stations to study the effects of long-term space missions on people and also to do experiments in low-gravity environments. Because astronauts live and work in near-weightlessness on space stations, scientists can do many experiments aboard that would not be possible on Earth.

Many people were sad to see the shuttle program end, but times were changing. The National **Aeronautics** and Space Administration (NASA) was getting out of the business of carrying people and things back and forth between Earth and space. Instead, NASA was returning to its original mission of focusing on space science and exploration. NASA planned new missions to send **robotic** rovers and people to exciting destinations, such as Mars. For the first time, the agency made the decision to turn over the more common types of missions to **commercial** companies.



In the post-shuttle era, NASA will focus more on space exploration missions. This artist's drawing shows how Mars rover Curiosity was designed to be gently lowered onto the Martian surface with the help of a "Sky Crane."

Yuri Gagarin (bottom right) became the first person to travel into space when he orbited Earth aboard a Vostok rocket (left) on April 12, 1961. The Gemini-Titan rocket (top right) helped the United States prepare to send astronauts to the Moon.

The Dawn of a New Era

Commercial companies had a lot to learn. Building spaceships is challenging. Designers and engineers must build vehicles that can function safely while using dangerous fuels, traveling at high speeds, and operating in extreme temperatures. They also have to create the systems that keep spaceships flying on course.

NASA scheduled SpaceX to begin delivering supplies and equipment to the ISS in 2012. Just as importantly, the delivery service also carries cargo back to Earth. When the Dragon leaves the ISS, it splashes down in the Pacific Ocean off the coast of California. SpaceX fishes the Dragon out of the water and reuses the capsule. The two parts of the Falcon 9 rocket are also designed to be reusable.

A SpaceX Falcon 9 rocket with a Dragon capsule sits on the launch pad at Kennedy Space Center in Cape Canaveral, Florida.

SpaceX is one company that has worked hard to develop a vehicle that can make regular deliveries to the ISS without costing too much. SpaceX has built a crewless, reusable spacecraft—the Dragon. The Dragon **capsule** rides into space on top of a Falcon 9 rocket, which is also designed and built by SpaceX. Once the Dragon capsule arrives near the ISS, it waits nearby so as not to accidentally bump into the station. When the ISS crew is ready, they use the station's robotic arm to grab the spacecraft and bring it in for **docking**.

A SpaceX Dragon capsule flies to the ISS in this artist's drawing.

When the Space Age began in the late 1950s, only the world's two superpowers—the United States of America and the Soviet Union—had the money, resources, and technology to build vehicles that could travel into space. Over time, though, more nations and even some commercial companies entered the space business. In the 1960s, private companies began building their own communications satellites, though they still relied on government launch vehicles to carry them up into space. By the 1980s, private companies were building their own rockets for launching satellites into orbit.

By the mid-1990s, it was clear that things were changing. Smaller, newer companies were entering the space business. What these companies lacked in experience, they made up for in enthusiasm. Computers and other advances in technology had put space within the reach of many **entrepreneurs**. Companies were competing with each other for a piece of the space business. Today, commercial companies are planning four kinds of space missions: taking tourists to the edge of space and back, delivering supplies and equipment to crews that are already in orbit, ferrying crews back and forth to space stations, and putting up new space stations of their own.

SpaceShipOne made history in 2004 when it became the first privately funded, non-governmental spacecraft to carry a person into space.

A Second Space Race

In 1996, a nonprofit educational foundation announced a special competition to speed up development of private spaceships, the Ansari X-Prize. The $10 million prize would go to the first private company to successfully build and pilot a spaceship into space with at least one person aboard and room to carry two others. To win the X-Prize, the spaceship would have to fly at least 62.1 miles (100 km) up, return to Earth, and then do the whole trip over again within two weeks.

Twenty-seven teams from seven countries joined the competition, but it took eight years for someone to claim the $10 million prize. An American company called Scaled Composites won with its vehicle, *SpaceShipOne*. The small spaceplane successfully made the first (and second) privately funded human spaceflights in 2004.

The space shuttle *Discovery* carries cargo to the International Space Station inside its payload bay in 2001.

Space Delivery Service

People living and working in space for long periods of time rely upon regular deliveries of supplies and equipment from Earth. Soon after the Ansari X-Prize competition ended in 2004, NASA announced it would offer prizes for private companies that were able to come up with creative and inexpensive ways to move cargo from Earth to the International Space Station (ISS). The winning companies would get money and technical assistance to build their designs. In response to NASA's announcement, even more private companies began working on new space vehicles. Suddenly it wasn't just NASA and other governments that were building spaceships. Many people could see the possibilities.

When *SpaceShipTwo* is ready to return to Earth, the pilot will tilt the wings to slow the vehicle down. With the wings in the tilted position, *SpaceShipTwo* will act like a giant badminton birdie and fall back to Earth much more slowly. Slowing *SpaceShipTwo* down this way keeps it from getting too hot during **re-entry**, so it doesn't need the heavy heat shield that many other spaceships use. Launching from *White Knight Two* allows the spaceship to use less fuel to reach space. These savings help keep the costs down.

Once the spaceplane has descended to an altitude of 13.2 miles (21.24 km), the pilot will move the wings back to the normal position to glide in for a landing on the big runway at Spaceport America in New Mexico. The entire flight is expected to take about two hours.

A model of *SpaceShipTwo* shows the wings in the tilted position.

In October 2014, one pilot died when *SpaceShipTwo* crashed in California during a test flight. Few advances in technology come without sacrifices. "Space is hard," said George Whitesides, CEO of Virgin Atlantic. The company plans to continue working toward safe commercial spaceflight.

To win the prize, Scaled Composites used two vehicles working together. *SpaceShipOne* didn't take off from a runway like an airplane or blast off on top of a rocket. Instead, it was carried high up into the sky under a special airplane known as *White Knight*. Once *White Knight* had carried *SpaceShipOne* up to 50,000 feet (15.2 km), it released the spaceplane from beneath its belly. Within seconds, *SpaceShipOne's* rocket engines roared, pushing the vehicle to over 3,000 miles per hour (4,828 kmph), almost four times the speed of sound. The small spaceplane then climbed past 62.1 miles (100 km), just beyond the edge of space.

An artist's drawing shows *SpaceShipOne's* rocket engine igniting seconds after release from its mothership, *White Knight*.

Ticket to Ride

SpaceShipOne was the **forerunner** of a new fleet of spacecraft that will carry tourists into space. The company Virgin Galactic has partnered with the makers of *SpaceShipOne* to make space tourism available to people all over the world. The company is already selling tickets for trips into space for $200,000 per passenger. While $200,000 is a great deal of money, it is less than one percent of what private citizens have paid to travel into space until now.

The Adventure of a Lifetime

Space tourism began in 2001, when American Dennis Tito paid $20 million to the company Space Adventures to catch a ride to the International Space Station aboard a Russian Soyuz rocket. Mr. Tito spent eight days aboard the ISS before returning to Earth. Following his flight, several other private citizens have each paid $20 million to $35 million to make similar trips to space. Among them were famous computer game designer Richard Garriott, and Iranian-American businesswoman Anousheh Ansari, whose family the Ansari X-Prize was named after.

Anousheh Ansari on the ISS in 2006

The First Space Tourists

Year	Name	Nationality	Cost	Time in Space
2001	Dennis Tito	American	$20 million	8 days
2002	Mark Shuttleworth	South African	$20 million	11 days
2005	Gregory Olsen	South African	$20 million	11 days
2006	Anousheh Ansari	Iranian/American	$20 million	12 days
2007	Charles Simonyi	Hungarian/American	$25 million	15 days
2008	Richard Garriott	American/British	$30 million	12 days
2009	Charles Simonyi	Hungarian/American	$35 million	14 days
2009	Guy Laliberté	Canadian	$35 million	11 days

All of the early space tourists used Soyuz rockets to travel to the ISS.

SpaceShipTwo is the spaceplane that Virgin Galactic will use to carry paying tourists into space. It has its own mothership, *White Knight Two,* and uses a design that is similar to *SpaceShipOne*, though it is larger so that it can carry two pilots and up to six passengers. Like *SpaceShipOne*, it is designed to fly to the edge of space and back, not to travel completely around Earth once in space. When they reach space, passengers aboard *SpaceShipTwo* will experience about six minutes of weightlessness before returning back home. The passenger area has many windows to give passengers incredible views of Earth and space.