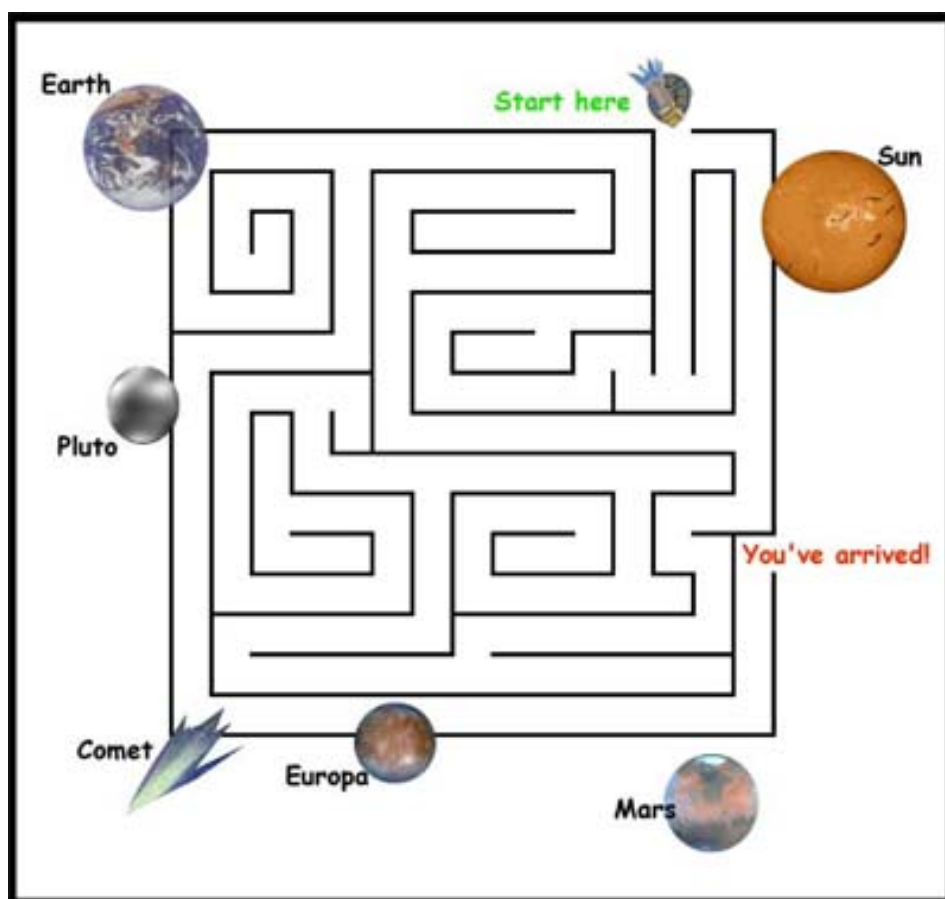


# WISCONSIN 4-H YOUTH DEVELOPMENT

## SPACE CAMP PRE-LAUNCH LEARNING GUIDE



Games and explorations to help you make the most of your Space Camp experience



This guide is a collection of several resources and is not meant to be distributed as an original work by the author. The information gathered in this document comes from a variety of public websites which are listed in the references section at the end of the document.

## Wisconsin 4-H Space Camp Pre-Launch Learning Guide

The first Earthling in space blasted off on November 3, 1957. Her name was **Laika** (Russian for Barker). Laika, the dog, was launched in the Soviet Union's **Sputnik 2**, the world's second **artificial satellite**. Space Science has changed a lot since this first exploration which occurred less than 60 years ago, but there is still much to learn about this mostly uncharted frontier. This booklet takes a look back at space science history and details what discoveries are currently taking place as humans continue to try to understand not only our small solar system, but all the systems in the universe yet to be discovered.

### What it takes to explore space?

When you think about space science, you might automatically think about astronauts. Astronauts are an important part of space science, but it takes hundreds and possibly thousands of other types of scientists to create vehicles that can travel into space and to design experiments to be performed in space.

Let's imagine that no earthling has ever gone into space. You are picked by the **National Aeronautics and Space Administration (NASA)** to plan a manned space flight to the moon, but since no one has gone into space, it's up to you to design a vehicle (spaceship) and interesting experiments to run to help us understand some aspect of space or the moon.

1. What types of scientists would you want to hire to make this mission a success? Try to be specific; don't just say engineer or scientist, but list what type of engineer or scientist you might want on your team.
  
  
  
  
  
  
  
  
  
  
2. What sorts of things might you like to study on the way to the moon and while stationed on the moon? This could be plants, animals, materials, laws of physics, etc. Remember, for this activity, imagine that we've never gone to the moon or even sent a human up into space, so don't worry about what may have already been studied...use your imagination.

3. Use a blank piece of paper to draw a prototype of your spaceship and moon space station.

As you may know, humans have traveled to the moon and we've made great leaps in our understanding of space. Right now, there are humans living on the **International Space Station (ISS)**, there are numerous **communication satellites** in orbit and the **Curiosity Rover** is traveling on the surface of Mars. But how did we get there? Well, in order to understand our current and future space travels, we need to delve into our past explorations.

### **Do YOU Use Products Developed by NASA?**

The answer is ABSOLUTELY! We all use or have knowledge of significant products developed by NASA for use on various space missions. Check the items below that you have used or that are a part of your life:

- ☐ Cell phone communication
- ☐ Digital camera or cell phone camera
- ☐ Scratch resistant lenses for eyeglasses and digital devices
- ☐ Invisible braces
- ☐ Water filtration units
- ☐ Memory foam mattresses
- ☐ Infrared thermometers: also known as ear thermometers
- ☐ Smoke detectors
- ☐ Cordless tools
- ☐ Ski boots
- ☐ Joy-stick gaming controller

### **ROCKETS AWAY!**

Humans have been curious about space possibly since the beginning of our existence, but the thought of traveling outside of our atmosphere did not seem conceivable until about 1865. In this year, in France, an amazingly forward thinking author named **Jules Verne** published a book called ***From Earth to the Moon***. Although this book was meant to be humorous and contained some very "fatal" scientific flaws, Verne did make an effort to do some calculations on what it might take to build a ship capable of traveling to space. Surprisingly, given there was very little information available at the time, many of his calculations were shown to be very close to reality. In addition, his work inspired pioneering space scientists like **Konstantin Tsiolkovsky** and many of the original rocket prototypes employed by NASA used portions of Verne's theories.

Of course taking words on a page to an actual rocket that can take a **payload** to space is not an easy task. Tsiolkovsky's theories, drawings and calculations were subsequently used to create the first rockets and earned him the title "**Father of Cosmonautics**".

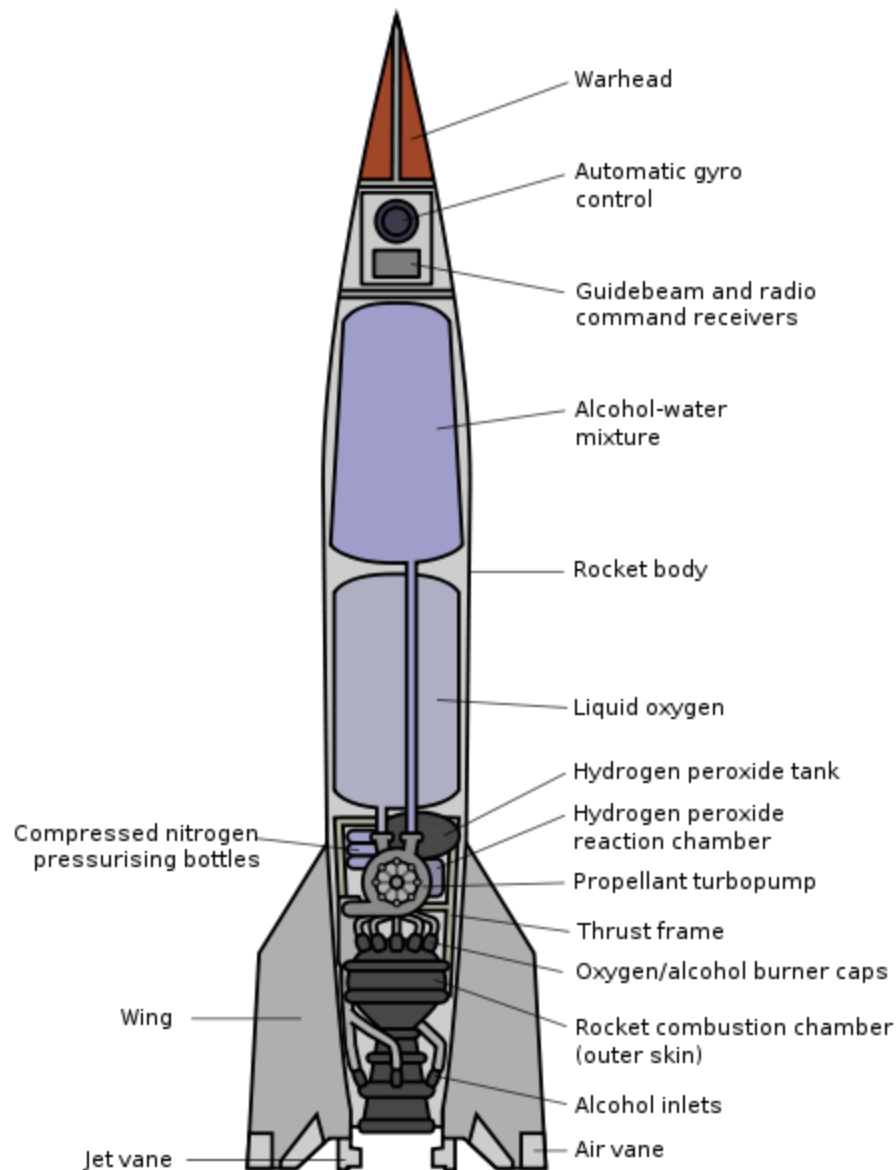
Tsiolokovsky was possibly the first, but not the only pioneer in early space history. In the United States and in Germany, two other scientists were investigating rockets and dreaming of space travel as well. **Robert Goddard** was an American professor, physicist and inventor who is credited with creating and building the world's first liquid-fueled rocket, which he successfully launched on March 16, 1926.

In Germany, **Hermann Oberth** was also experimenting with rocketry and liquid fuel propellants. The German military quickly realized the potential for their work in war-time weaponry and successfully recruited Oberth's student, **Wernher von Braun** to develop rockets. These rockets were not space bound, but were used to bomb certain areas in Europe during World War II.

In the late 1930's, von Braun became the central figure in Germany's rocket development program, responsible for the design and realization of the **V-2 combat rocket** during World War II. After the war, he and some select members of his rocket team were taken to the United States as part of the then-secret **Operation Paperclip**. Von Braun worked on the United States Army intermediate range ballistic missile (IRBM) program before his group was recruited by NASA. During his time in the U.S., von Braun became the chief architect of the **Saturn V** launch vehicle, the superbooster that propelled the Apollo spacecraft to the Moon.

### Word Find:

N W H H B N X T T Y D N A D D	
Z U C A J Z E S W T H F B R L	EXPLORER
L Q A E P A P I G M X J A A E	GODDARD
R Z L R F W Q O Z C W D U Z C	KOROLEV
O E F M B Q O L I H D N V I S	LAUNCH
S A T U R N V K F O C J U P K	OBERTH
R T J R M B O O G H U A A E O	ROCKET
E E E G P P M V S H V C Z N R	SATELLITE
R D B K T A Y S C P E I H R O	SATURNV
O M X B C V W K B R U A C E L	SPACERACE
L A X Y F O Z Y A H B T I V E	SPUTNIK
P Q T O I M R C V S X W N P V	TSIOLKOVSKY
X E T I L L E T A S E R H I K	VERNE
E H T R E B O N O F E W Q S K	VONBRAUN
P C A W Q W B W O K T Z V C O	



Schematic of the V-2 Rocket

## The Journey to Space

The research done during and shortly after WWI made the idea of space travel a seemingly attainable goal. With most of Germany's research capabilities destroyed during the war another world power took the stage in the development of space programs. With the help of a rocket created by famed rocket designer **Sergei Korolev**, the Soviet Union launched an **artificial satellite** into space on October 4, 1957. **Sputnik 1**, an aluminum sphere weighing about 184 pounds, was the first man-made object to orbit Earth. A month later, on November 3, **Sputnik 2** launched, along with Earth's first living creature to go into space, canine passenger **Laika**. Monitoring equipment showed the launch had minimal effects on Laika, and the weightlessness had no adverse effects. However, Laika did not survive the return to Earth.

Sputnik's launch, referred to by some in the United States as "the Sputnik crisis," signified the start of the **space race** between the Soviet Union and the United States. The goal of the space race was to see what nation would be the first to send a person to space successfully. With the successful launching of Sputnik 2, the U.S. placed significant emphasis on designing and sending an un-manned satellite to space. On January 31, 1958, the United States launched its first satellite into space, named **Explorer 1**.

### Getting to Orbit and Back: Gemini Program

After the successful launch of Explorer 1, all objectives turned to sending a human into space. In 1959, NASA chose seven pilots to train and prepare for space flight. This space mission was termed Mercury. The overall goals of the Mercury Program were:

- To orbit manned spacecraft around the earth
- To investigate man's ability to function in space
- To recover both man and spacecraft safely

There were two kinds of missions: suborbital and orbital. In the suborbital flight, the space craft went directly from launch to re-entry at the highest point; in the orbital mission on the other hand, the craft went into an orbit around the Earth. To achieve orbital flight a higher speed and altitude and thereby bigger rocket was needed. In total, the program included 20 unmanned launches, followed by two suborbital and four orbital flights.

In 1961, after several frustrating launch attempts, U.S. astronaut **Alan B. Shepard** became the first Mercury astronaut to successfully complete a suborbital flight in a spacecraft he called **Freedom 7**. However, one month earlier the USSR was successful in sending the first man into space. **Yuri Gagarin**, flying aboard **Vostok 1**, not only successfully achieved space flight, but also orbited the earth one time before he parachuted safely back to earth.

Beginning with Alan Shepard's *Freedom 7* flight, the astronauts named their own spacecraft, and all added "7" to the name to acknowledge the teamwork of the Mercury astronauts.

Rocket	Craft	Astronaut	Date	Duration	
Mercury Redstone	<i>Freedom 7</i>	Alan Shepard	1961	15 m 28 s	First American to make a suborbital flight into space
Mercury Redstone	<i>Liberty Bell 7</i>	Virgil "Gus" Grissom	1961	15 m 37 s	Second suborbital flight. Spacecraft sank before recovery when hatch unexpectedly blew off.
Mercury Atlas	<i>Friendship 7</i>	John Glenn	1962	4 h 55 m 23 s	First American to orbit the Earth (3 times).

Mercury Atlas	<i>Aurora 7</i>	Scott Carpenter	1962	4 h 56 m 15 s	Three orbits. Reentered off-target by 402 km. Carpenter replaced Deke Slayton.
Mercury Atlas	<i>Sigma 7</i>	Wally Schirra	1962	9 h 13 m 11 s	Six orbits. Textbook perfect flight
Mercury Atlas	<i>Faith 7</i>	Gordon "Gordo" Cooper	1963	1 d 10 h 19 m 49 s	22 orbits. First American in space for over a day. Last American to be launched solo into Earth orbit.

### Astronauts Outside the Spacecraft- Gemini Program

With the mission to send a human into space complete, NASA launched the second space program called Gemini. Gemini utilized a two-stage rocket (**Titan II**) and the capsule was created to hold two passengers instead of one. The Gemini Program objective was to develop space travel techniques in support of Apollo, which had the goal of landing men on the Moon. Gemini achieved missions long enough for a trip to the Moon and back, perfected **extra-vehicular activity (EVA)** and orbital maneuvers necessary to achieve **rendezvous** and docking. The Gemini Program was also the first space program to create **mission patches** for each flight. The individual patches represent the mission goals and pays tribute to the astronauts on each crew.

There were two unmanned Gemini flights (Gemini I and II) in 1964 and 1965, followed by 10 manned flights in 1965 and 1966. Ed White became the first American to perform an EVA; however, the Soviets again stunned the world on March 18, 1965 with the **first EVA** performed by **Alexey Leonov** from the **Voskhod 2** spacecraft.

### Landing on the Moon- Apollo Mission

The Apollo Program missions needed newly designed modules and were the first to include lunar modules. The **Command Module (CM)** was the conical crew cabin, designed to carry three astronauts, one more than the two person Gemini modules, from launch to lunar orbit and back to an Earth ocean landing. A cylindrical **Service Module (SM)** supported the Command Module, with a service propulsion engine and a fuel cell power generation system. The Service Module was discarded just before re-entry. Typically, these two modules are combined into one name: the **Command Service Module (CSM)**. In contrast to the CSM, the **Lunar Module (LM)** was designed to descend from lunar orbit to land two astronauts on the Moon and take them back to orbit to rendezvous with the Command Module.

Apollo missions also required a much larger launch vehicle (rocket) to reach the moon. Wernher von Braun and his team designed the **Saturn** family of rockets to meet this need. The **Saturn 1** and **Saturn 1B** rockets were used for the first Apollo test missions. However, the **Saturn V** (Saturn 5) rocket was the launch vehicle designed to perform a **lunar orbit** and subsequently send the first human to land on the moon. Saturn V was first used in Apollo mission 8, which was the first successful manned lunar orbit.



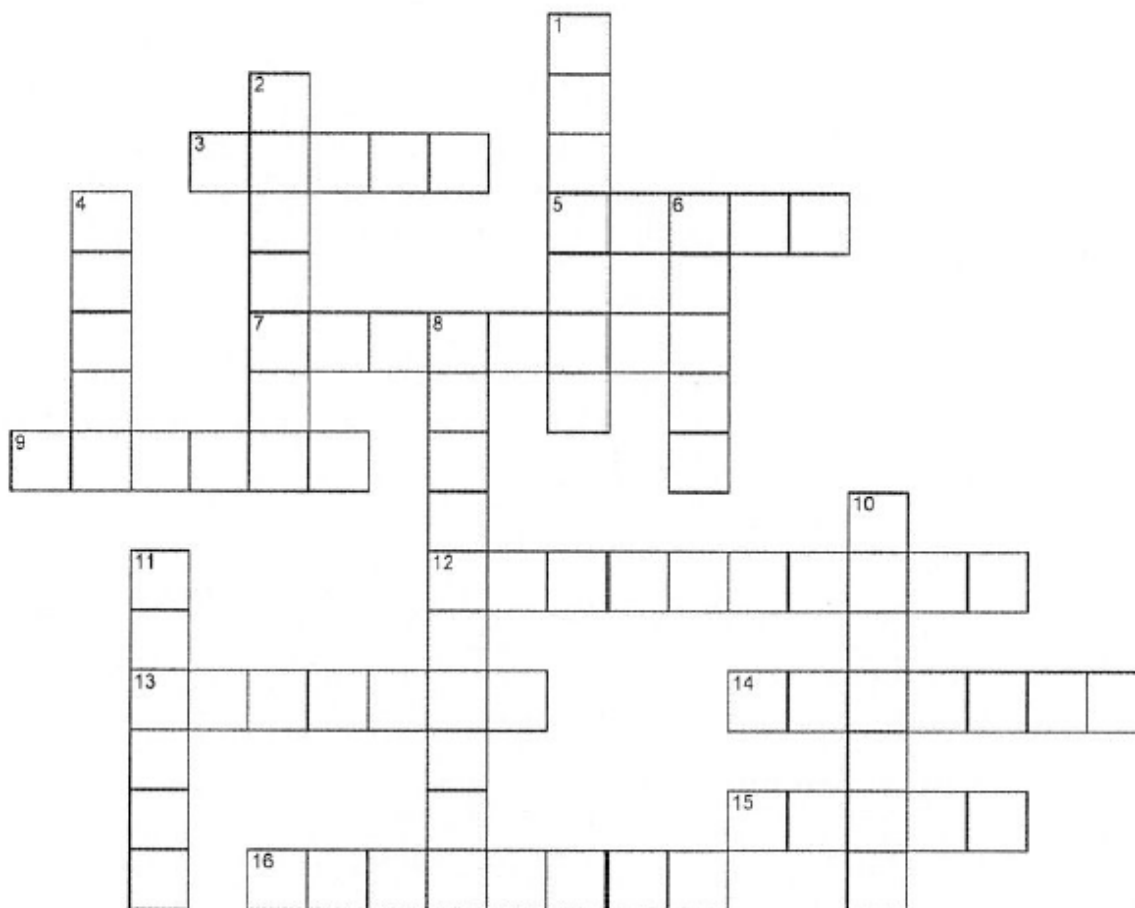
The Apollo Program suffered some major setbacks during the initial test flights and launches. The Apollo 1 test mission led to the deaths of the entire crew when a fire broke out in the cockpit before launch. **Grissom, White** and **Chaffee** died of asphyxiation when they were forced to breath in the hot, toxic fumes caused by the fire. As a result, NASA did not test another manned Apollo mission until Apollo 7, piloted by **Wally Schirra**.

On **July 16, 1969, Apollo 11** became the first craft to land on the moon with its three man crew of **Neil Armstrong, Buzz Aldrin** and **Michael Collins**. Apollo 11's **CSM- Columbia** and **LM-Eagle** traveled four days to reach the moon and experienced several alarms and malfunctions as it reached the moon's surface. However, **Eagle** successfully landed at **Tranquility Base** (the selected place on the moon's surface suitable for landing) and astronauts Neil Armstrong and Buzz Aldrin were the first men to walk on the moon's surface.

After Apollo 11, NASA launched six more Apollo missions. All were successful in landing on the moon except **Apollo 13**, which earned the name "**The Successful Failure**". Although Apollo 13 failed to launch the LM to the moon, the astronauts succeeded in returning to the earth safely after an explosion of an on-board oxygen tank. The astronauts had to live in the LM and ration food and water while enduring freezing cold temperatures.

Apollo Mission	Command Service Module (CSM)	Lunar Module (LM)
Apollo 9	Gumdrop	Spider
Apollo 10	Charlie Brown	Snoopy
Apollo 11	Columbia	Eagle
Apollo 12	Yankee Clipper	Intrepid
Apollo 13	Odyssey	Aquarius
Apollo 14	Kitty Hawk	Antares
Apollo 15	Endeavor	Falcon
Apollo 16	Casper	Orion
Apollo 17	America	Challenger

# Space Science



## ACROSS

3. The first earthling in space; also Russian for barker
5. The name of the first manned lunar module craft to land on the moon.
7. The rocket used to launch manned suborbital flights, but not orbital flights, as part of the Mercury Program
9. The name of the second U.S. Space Program
12. A planned meeting of objects in space.
13. The first artificial satellite successfully launched into space.
14. The name of the command service module on the Apollo 9 mission.
15. \_\_\_\_\_ module is the capsule that is designed to land on the moon.

16. The first artificial satellite launched by the U.S.

DOWN

1. The craft Alan Shepard took to space as part of the Mercury Program.
2. The last name of the first man in space.
4. The last name of the first American to perform an extravehicular activity (EVA).
6. The last name of the 1<sup>st</sup> American to orbit the Earth.
8. A flight where the craft reaches space but does not complete an orbital revolution.
10. \_\_\_\_\_ module is the crew cabin of a space craft.
11. The first spacecraft to carry a human into space and to orbit the earth.

### **Humans Living in Space: Salyut Program**

The Soviet Union launched the first space station to orbit earth on April 19, 1971. **Salyut 1** was launched unmanned using a **Proton-K** rocket. The first crew launched later in the **Soyuz 10** mission, but they ran into trouble while docking and were unable to enter the station; the Soyuz 10 mission was aborted and the crew returned safely to Earth. The second crew was launched in **Soyuz 11** and remained on board for 23 days. This was the first time in the history of spaceflight that a space station had been manned, and a new record in time spent in space. This success was however overshadowed when the crew was killed during reentry, as a pressure-equalization valve in the Soyuz 11 reentry capsule had opened prematurely, causing the crew to suffocate.

### **Skylab Program**

The Apollo Program reached the goal of sending a manned flight to the moon and collecting valuable data about the moon's surface. The **Skylab Program** followed the Apollo Program with a goal of sending humans to space for long periods of time and performing scientific experiments on humans, plants, and animals.

High school students from across the United States participated in the Skylab missions as the primary investigators of experiments that studied astronomy, physics, and fundamental biology. The student experiments performed on Skylab 3 included the study of clouds, x-rays from Jupiter, in-vitro immunology, spider web formation, cytoplasmic streaming, mass measurement, and neutron analysis.

### **Space Shuttle Program**

The **Space Shuttle Program**, which was officially called the **Space Transportation System (STS)**, was started even before Skylab 1 was launched into orbit. The goals of the Space Shuttle Program were very different than the previous missions, where only significantly trained astronauts were sent with specific mission objectives. In contrast, the Space Shuttle Program was hoped to open space flight to everyone and the shuttle was designed to be reusable and

inexpensive. The design of the shuttle was also significantly different than previous space vehicles.

The Space Shuttle was the first operational orbital spacecraft designed for reuse. It carried different payloads to low Earth orbit, provided crew rotation and supplies for the International Space Station (ISS), and performed servicing missions. The orbiter could also recover satellites and other payloads from orbit and return them to Earth. Each Shuttle was designed for a projected lifespan of 100 launches or ten years of operational life, although this was later extended.

Between the first launch on April 12, 1981, and the final landing on July 21, 2011, NASA's space shuttle fleet flew 135 missions. Major missions included launching numerous satellites, interplanetary probes, the Hubble Space Telescope (HST), conducting space science experiments, and constructing and servicing the International Space Station. The Space Shuttle Program ended after Atlantis landed at the Kennedy Space Center on July 21, 2011.

### **Space Shuttle Disasters**

On January 28, 1986, *Challenger* disintegrated 73 seconds after launch due to the failure of the right SRB, killing all seven astronauts on board. The disaster was caused by low-temperature impairment of an O-ring, a mission critical seal used between segments of the SRB casing. The failure of a lower O-ring seal allowed hot combustion gases to escape from between the booster sections and burn through the adjacent external tank, causing it to explode.

On February 1, 2003, *Columbia* disintegrated during re-entry, killing its crew of seven, because of damage to the wing caused during launch. During launch, a piece of foam insulation the size of a small briefcase broke off from the Space Shuttle external tank. The debris struck the leading edge of the left wing, damaging the Shuttle's thermal protection system (TPS), which shields the vehicle from the intense heat generated from atmospheric compression during re-entry. While *Columbia* was still in orbit, some engineers suspected damage, but NASA managers limited the investigation, on the grounds that little could be done even if problems were found.

### **Mir Space Station**

Following the success of the Salyut program, **Mir** represented the next stage in the Soviet Union's space exploration. Mir, which means Peace in Russian, was a space station that operated in low Earth orbit from 1986 to 2001, at first by the Soviet Union and then by Russia. Mir served as a microgravity research laboratory in which crews conducted several scientific experiments in order to develop technologies required for the permanent occupation of space.

### **The International Space Station (ISS)**

The **International Space Station (ISS)** is a habitable artificial satellite in low Earth orbit. It follows the Salyut, Skylab and Mir stations as the ninth space station to be inhabited. The ISS Program is a joint project between five participating space agencies: NASA, the Russian Federal Space Agency, Japan Aerospace Exploration Agency, and the European Space Agency. ISS components have been launched by American Space Shuttles as well as Russian Proton and Soyuz rockets. On 25 May 2012, **Space Exploration Technologies Corporation** (or **SpaceX**) became the world's first privately held company to send a cargo load, via the **Dragon**

spacecraft, to the International Space Station. The ISS is maintained at an orbital altitude of between 205 miles and 255 miles. It completes 15.7 orbits per day. The ISS is funded until 2020, and may operate until 2028.

The ISS serves as a microgravity and space environment research laboratory in which crew members conduct experiments in biology, human biology, physics, astronomy, meteorology and other fields. The station is suited for the testing of spacecraft systems and equipment required for missions to the Moon and Mars.

### **Private Space Exploration Companies**

Since then, several private companies have developed and tested space craft capable to reach space and send personnel to the ISS. Space Exploration Technologies (SpaceX) successfully launched the Dragon spacecraft this evening from Cape Canaveral, Florida. Dragon was launched atop **SpaceX's Falcon 9 rocket** for the first of twelve Commercial Resupply Services (CRS) missions contracted to NASA. Dragon carried approximately 1,000 pounds of critical supplies, including food, water, scientific experiments and Space Station parts. Bigelow Aerospace, Orbital Sciences Corporation, Virgin Galactic and Boeing all have space crafts and rockets in development. A recent article stated that Boeing is hoping to sell commercial space flight tickets as soon as 2015.

### **Curiosity Rover-Mars Exploration**

The **Curiosity rover** is a car-sized robotic rover exploring Gale Crater on Mars as part of NASA's Mars Science Laboratory mission (MSL). *Curiosity* was launched from Cape Canaveral on November 26, 2011, and successfully landed on Aeolis Palus in Gale Crater on Mars on August 6, 2012. The rover's goals include: investigation of the Martian climate and geology; assessment of whether the selected field site inside Gale Crater ever has offered environmental conditions favorable for microbial life, including investigation of the role of water; and planetary habitability studies in preparation for future human exploration.

### **Unscramble the words**

usyatl		The first space station
bylska		Program that studied spider webs
sreetmxepn		Methodical procedures to collect data
ramnsoyto		The study of space
rtjpiue		A planet
ccepraafs		Travels into space
uolbimac		Space shuttle that exploded
atantisl		Final space shuttle

hbbuel		Space telescope
folanc		SpaceX rocket
gradon		Private company spacecraft
cruiosyti		Currently exploring Mars

### **References:**

This guide is a collection of several resources and is not meant to be distributed as an original work by the author. The information gathered in this document comes from a variety of public websites including:

[http://en.wikipedia.org/wiki/Space\\_science](http://en.wikipedia.org/wiki/Space_science)

<http://ngm.nationalgeographic.com/2007/10/space-travel/space-timeline-interactive>

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[http://en.wikipedia.org/wiki/Salyut\\_programme](http://en.wikipedia.org/wiki/Salyut_programme)

<http://en.wikipedia.org/wiki/Mir>

<http://en.wikipedia.org/wiki/Skylab>

<http://en.wikipedia.org/wiki/ISS>

[http://en.wikipedia.org/wiki/Hermann\\_Oberth](http://en.wikipedia.org/wiki/Hermann_Oberth)

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[http://en.wikipedia.org/wiki/Mercury\\_spacecraft](http://en.wikipedia.org/wiki/Mercury_spacecraft)

<http://spaceplace.nasa.gov/>