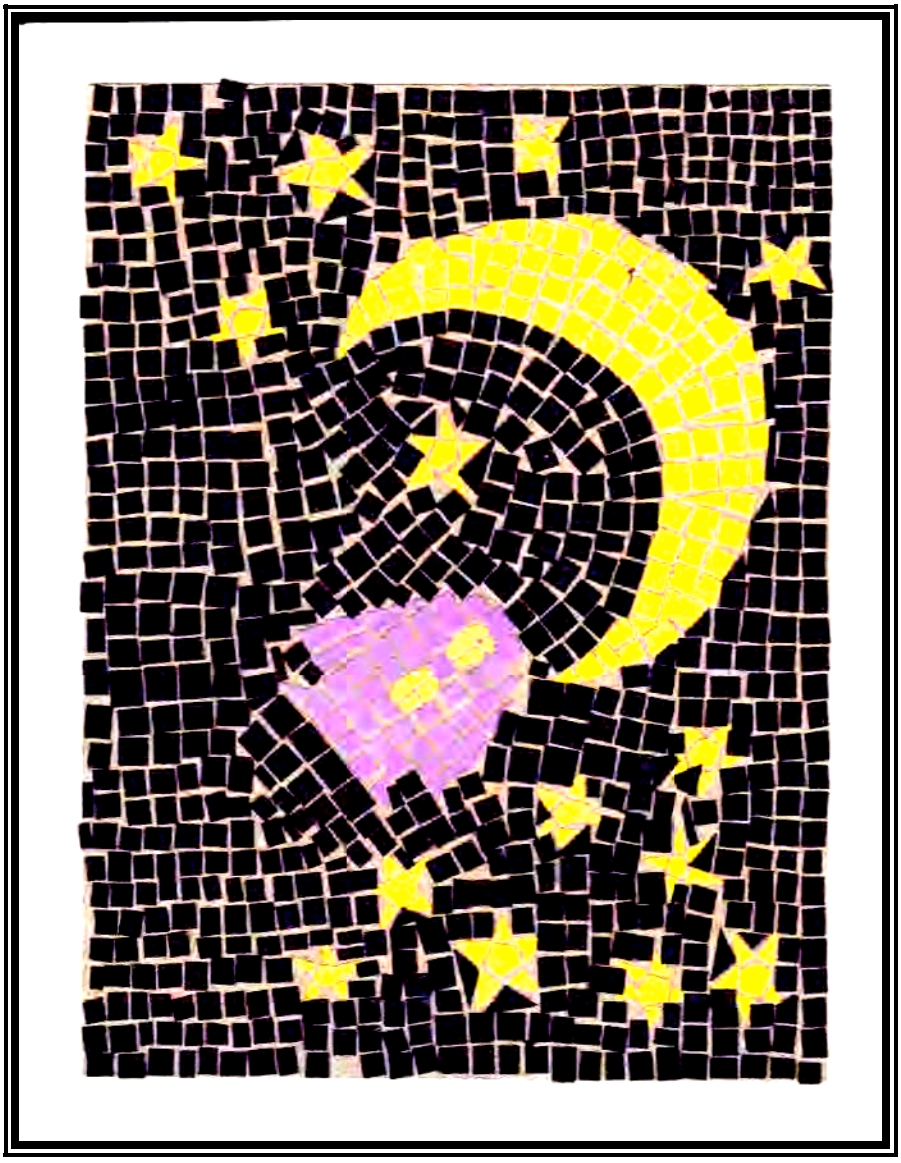
Space: Where Are We Going?
Synthesis Unit
January 28-30, 2013



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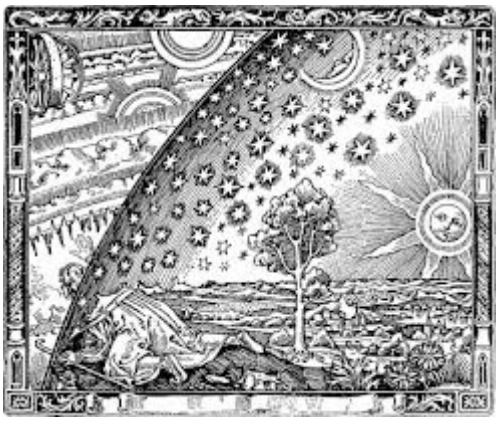
Ancient Astronomy



(Flammarion Engraving)[1]

Mayans, Incas, and the Aztec

The Mayans recorded and took the time to interpret everything about the sky. They believe that the planets, stars and the moon could understand the gods' actions. Since they believe the gods' actions were interpreted by the sky, they spent a lot of time studying the stars, the moon, and the planets, especially Venus. They spent a lot of time constructing many of their buildings that centered on astronomy. The buildings were aligned to match certain planets, stars, etc. which they were trying to study. The Mayans were very accurate with their predictions and used very sophisticated mathematics. They also had a calendar, which was made using their knowledge of astronomy. The Mayans were one of the past civilizations in Mesoamerica that had developed a written language. Though the Spanish conquerors destroyed most of their books, there was still some proof that the Dresden Codex had been made up by them. The Dresden Codex is detailed writing about the astronomical observations. The Mayans wanted to understand the repetitions of the movement of the planets and moon so that they were able to predict what would happen in the future. To be able to predict such things, they had to come up with

[1] *Flammarion Engraving* (Artist Unknown: First documented by Camille Flammarion in 1888.)

a mathematical system. The system they made was a base 20 system. The Dresden Codex contains things such as a table of eclipse that predicted the times when an eclipse might occur, a Venus table, and a Mars table. Venus was an important planet; they used Venus to plan wars. The Sun was also important. The sun god, Kinich Ahau, was one of the most powerful God that they had.

The Incas also kept very precise recordings of what they saw in the sky. They did not have any writing to show what they had known. They kept the cycle of the sun and moon over a year on *quipus*, which are knotted strings. By keeping track of the days they could predict when the next solstices and equinoxes would happen. In Cuzco, their capitol city, they would build places which would mark the horizon and the points which the sun would rise and set on the days of the solstices and equinox. The Incas had constellations just like we do now. They made stories up about the constellations and why they were there. They took looking at the stars very seriously. The stars would tell them when to harvest, plant and what the weather would be like. Usually the people who manned the stone towers were priests, so they knew when to conduct their rituals. They had to keep exact information on the movement of the sky.

The Aztec people paid attention to astronomy because they thought the sun, moon and stars had religious symbolism. They used astronomy to make calendars, buildings, and the celestial cycle. The celestial cycles allowed them to be able to track the length of the solar year, the lunar months and the revolution of Venus. Similar to the Mayans, they found out that Venus had an orbit of 584 days around the Earth. The Aztec had a two-calendar system. The first one was the solar year calendar; it had a cycle of 365 days, with 18 months and 20 days in each month. This is also known as the Sun Calendar. The Sun Calendar, which was very big, was placed on top of the temple in Tenochtitlan. In the middle of the Sun Calendar there was a face of Tonatiu, who was the sun god and surrounding the face there were 20 things in nature that represented everyday life. The sun calendar is 12 feet across, weighs 24 tons, and is three feet thick. It took them about 50 years to make the calendar. The second calendar was made up of 260 days with 20 days. Similar to the Sun Calendar the twenty days represented familiar things of nature in them.

The Mayans, Incas and the Aztecs are all similar in many ways from looking at the sky and their buildings being created around the planets, stars and the sun. They are all different in many ways. The Mayans were more into their gods. They were also the most advanced out of them all considering that they had come up with a mathematical system and they also had a written language. The Incas were also advanced in the way that they had a system to keep track of the cycles of the sun and moon. Though their focus was more on the sky. The Aztecs were also smart as well creating calendars, which would predict things for thousands of years, though, the world did not end in 2012, most of their other predictions were true. They were all different but they all looked to the sky to find some sort of answer and stable movement of the world around them and the earth.

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Egyptian and Babylonian Astronomy

Two of the oldest astronomical cultures were the Egyptians and the Babylonians. (They were practicing their own astronomy about 30 centuries ago.) They found a lot of details that are astronomically important and included that in their cultures.
The oldest known significant astronomical text is Tablet 63 of a group of Babylonian cuneiform tablets called *Enuma Anu Enlil*. It lists the first and last visible risings of Venus over a period of about 21 years. This was the first known evidence that planet phenomena are periodic.

In Babylonia, the reign of Nabonassar (from 747-733 BC) marks an increase of systematic observation recordings. The frequency and quality the people put into the recordings showed how important astronomy was to them. These observations allowed future discoveries like the discovery of an 18 year cycle of lunar eclipses.

The Egyptians had good technical skill and observation recordings. They figured out that when the star Sirius rose before the sun, the flooding of the Nile River started (an agriculturally important event for them). They aligned the pyramids with the Pole Star. (At that time the Pole Star was Thuben.) The Egyptians created a whole religion based on the sun, moon, and certain stars. They had a sun god, Ra, whom they believed to be a divine pharaoh. They had a moon god, Khonsu. They thought constellations were pictures of the gods. The Babylonians chose to not have a religion based on astronomy.

Tables of stars and inscriptions in tombs of the Pharaohs Ramesses VI and IX led scientists to believe that the Egyptians had a system of determining the hours of the night. A man would face an astrologer in such a way that the Pole Star would pass over part of his head or shoulders. The astrologer would use this location on the man to estimate the hours of the night. In expert hands, this trick could work with a high degree of accuracy.

The Egyptians built temples so that light would shine in at one time every year! The Babylonians had a yearly calendar based on one star! (It was not very popular, but it was created). If astronomy wasn't as important to them and these small discoveries had not been made, we might not be as far along in learning about space as we are now! If ancient cultures like these had not concentrated on astronomy, we now might not have bothered to learn about astronomy in the first place!

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Astronomy in Mesopotamia

Astronomy started with the first settlements of farmers in Mesopotamia approximately 10,000 years ago. Mesopotamia is the land between the Tigris and the Euphrates Rivers, which is known as Iraq today. The oldest record of astronomy was found in Ancient Sumeria. The Babylonians and Assyrians based and developed their astronomy on the Sumerian’s legacy. Today, astronomy and astrology are two different concepts, but in the time of Mesopotamia, they were both related. Astrology is the study of the movements and relative positions of the celestial bodies interpreted as having an effect on humans and nature. The Mesopotamians studied the sky because they believed the gods lived up there. It was natural for them to observe celestial objects, in order to get cues from their gods. Many gods had nothing to do with the heavens. In the city, there was a moon-god called Sin, and the cities of Larsa and Sippar had a sun-god named Slamash. For several cities, Venus was the god Ishtar.

For the Mesopotamians, Earth was a large, flat disc with a dome on top. The dome represented the heavens. Scattered across the land were observatories with priests and educated people tracking the skies day and night. Priest astronomers were powerful, since kings and nobles depended on their predictions. The priest astronomers observed the skies with hollow tubes, sundials, and clocks that indicated time using water or shadows. Stunningly, their observations were very accurate. For instance, astronomical tablets from Ancient Sumeria record the rising and setting of Venus over a period of six years. They also indicated the astrological effects of the planet’s movements over their lives. For example, in one tablet, we read: “Venus disappeared in the West. Three days it stayed away, then became visible in the East. Spring will open and Adad [the thunder god] will bring his rain and Ea [the water god] his floods.”(Schomp, 73.)

The Sumerians invented cuneiform writing. They marked soft clay with a wedge-shaped stylus, and then put the clay to dry in the sun. The Babylonians adapted this form of writing, and also inherited the Sumerians’ number system. The number system used a place value notation with a base of 60. For example, they would write 23 as >>III.

Today we use a base 10 system which we adopted from the Babylonian system when we write a time in hours, minutes and seconds (example, 10:30:28=10 hours, 30 minutes, 28 seconds), or an angle in degrees (90°). Sumerians and Babylonians invented tables of numbers such as multiplication tables, tables of reciprocals, for squares, and even for square roots. The tablets found prove that many of the priests were experts in arithmetic.

The Sumerian year was composed of 12 months, and it followed the phases of the moon. Agricultural events such as planting and harvesting were mentioned in their calendars. The Sumerian day had 24 hours (12 hours of daylight and 12 of night time). Each hour was divided into 60 minutes, and each minute was composed of 60 seconds. Between 3000 and 2000 BC, the Sumerians and then the Babylonians invented the constellations (Leo, Taurus, Scorpius, Auriga, Gemini, Capricorn, and Sagittarus). They used the constellations for agricultural purposes and also to measure time.

Sumerians, Babylonians and Assyrians passed on their knowledge to the Greeks and eventually to us today.

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Islamic Astronomical History

The pre-Islamic Arabs relied entirely on empirical observation, unlike most ancient civilizations. The observations that they were making were based on the rising and setting of chosen stars. This method of studying was called Anwa. After Islamization, they continued to practice Anwa. Soon after Islamization, astronomers added mathematical methods to their simple observation process. The significant events in Islam's astronomical history are separated into four different periods in history.

From 700 AD to 825 AD, a Persian astronomical text, *Zij al-Sindhind*, was translated into Arabic. This allowed them to further their studies. The knowledge that they gained from these texts brought them much new mathematical advancement, like the sin function.

From 825 to1025 AD, the Islamic astronomers started to really get into researching astronomy. After much research and coming up with many of their own ideas, they accepted the new Ptolemaic system of astronomy. Not only did they accept the Ptolemaic

system, but they also made many new advancement within the system. The research was supported by Abbasid Caliph al-muman and the House of Wisdom. Soon after the acceptance of the Ptolemaic system, the first Muslim astronomical work was done on the study of the movements of the sun, the moon, and the 5 known planets. The research was done by Zi al-Sindh in 830. Because the Islamic people were making so many advancements, people where starting to doubt the Ptolemaic system. In 850 al-Farghani wrote the book *Kitab fi Jawani* that summarizes all the things that were wrong in the Ptolemaic system.

In 1025-1450 AD, Islamic astronomers had made such progress in understanding astronomy, they began to question the Ptolemaic system once again and began a reformist project. One of the most influential astronomers in Islamic history, Al-haytham, wrote *Al-shukuk*. This was a book of all of his doubts about the Ptolemaic system.

The period of 1400-1900 was known as the period of stagnation, where everyone was finally content with the current system of astronomy and continued to practice it for many years.

Islam has had a huge influence on the formation of our current astronomical practices and now has a formal process for analysis. No new changes or innovations have been made in recent years.

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When Astronomy and Philosophy Meet

The Greeks were not the first to look up at the stars, but the discoveries they made helped our modern scientists such as Sir Isaac Newton and Albert Einstein. They were very advanced for their time, and most of our nomenclature in astronomy comes from the Greek. The word astronomy itself comes form *astro* (the stars) and *nomy* (the law). Planet comes from the Greek word for wonderer. Also the names of the planets in our solar system are from their mythology, such as Venus, the Goddess of Love or Mars, the God of War. They didn't see astronomy so much as a physical phenomenon, but more as a philosophical issue, a description of Heaven, and a branch of mathematics.

In this essay, we are going to study the evolution of astronomy during Ancient Greek times.

It all started in 700 BC, when the Greeks looked up to study the sky. They were using that data to measure time; day and night were easy to define but the months and years were constantly redefined. They divided them by following what constellation was in the sky, which gave birth to our Zodiac signs. From the 21st of June to the 22nd of July the Cancer constellation is present in the middle of the sky at night. First seen as 12 months of 30 days, then as 6 full months and 6 empty months, this calendar had to be adjusted frequently. It was only in 600 BC that the Greeks started to wonder what was really happening.

That was the time of Thales. He was the first philosopher and well-known mathematician. He brought much knowledge from the Egyptians and even from the Babylonians. He thought that every star, the moon, and the planets were differentiated by the sort of water on their surfaces.

A hundred years later came Pythagoras. He was the first to understand that the last star in the morning and the first in the evening was actually the same star: Venus. Some believe that he knew long before Copernicus that the Earth was round, but his belief was less based on mathematical evidence and observations, than on the thought that a sphere is the most perfect shape, and that, without such perfection, all would be chaos. He also created a school that lasted over nine generations. They were called the Pythagoreans. It was almost a religion, a cult to Pythagoras and mathematics. They also believed in an anti-earth, a planet that we cannot see because it is hidden by the sun. One of his disciples, Philolas, also said that the Earth was round and talked about a fire in the middle of everything. This fire he was talking about was not the sun but an invisible fire. Fifty years after him, Ecphantos, the Pythagorean, proposed a rotation of the Earth. He was also the one that noticed that the moon rotated in an inclined orbit. His work inspired some modern scientists such as Sir Isaac Newton, but particularly Albert Einstein.

In 414 BC, Meton, who was famous and widely know from the play *The Birds*, written by Aristophanes, in which he is described as arrogant. The parapegma is attributed to him and another philosopher, Euclemon. A parapegma was a stone tablet with movable pegs and an inscription to indicate the approximate correspondence between the rising of a particular star and the calendar date. The movable pegs allowed the calendar to be adjusted when needed; it was very practical since the antique calendar was perpetually modified.

Let's move 100 years forward, to the time of Plato. Plato's influence is considered detrimental to astronomy. Indeed, Plato was not even seeing astronomy as a proper subject, but more as a part of mathematics, a beautiful geometrical theory, nothing more. He was mostly famous for his philosophical ideas. He also created a school. Eudoxus, who lived at the same time as Plato, proposed a circular model or seven heavenly bodies that can remind us of our eight planets.

A bit later came Aristotle. He brought much more to philosophy than to astronomy. Indeed, his ideas in this science were basically wrong but his contemporaries

considered them as fundamentally true, which help back a few generations and slowed the progress of science. Yet, he wrote down many if Pythagoras' ideas, whom he agreed with, which permits us to have a trace of them. His principle idea was that everything was composed of five elements: Water, Fire, Earth, Air, and Quintessence. That last one would be the "god element," and what causes gravity. Maybe he wasn't so wrong since what actually causes gravity, the Higgs Boson, is called the God Particle.

Some time after, Archimedes measured the apparent surface of the sun. In the meanwhile, Erathothenes managed to calculate pretty closely the size of the Earth by calculating the angle between the tropic and Alexandria with a wooden stick and his shadow. In the 3rd Century before Christ, Aristarchus pointed out that the sun was much further than the moon from the Earth by trying to calculate, unsuccessfully, their distances. He also believed the sun was much bigger than the Earth. He even proposed the first heliocentric system, but the idea was not well received in Greece. Hiparchus, considered as the most important Greek astronomer around 150 BC, was able to describe the motion of the sun and the moon, the orbit of the moon, the size of the moon and the sun, to predict eclipses, and he wrote a catalog of the start full of data. Far later, in the 2nd Century after Christ, Ptolemy wrote 13 volumes about Greek astronomy and mostly about Hipparchus. He is one of the main sources we have from all the work of our Greek ancestors. He was also able to predict the placement of the planets with small errors.

Some Arabic scientists went to Greece and translated many documents of Ptolemy and Plato. Those translations are what we have left from the emergent Greek period. Indeed, with the rise of Christianity, the antique works were considered as evil; they were destroyed, the Library of Alexandria burned, and the great thinkers forced into silence and ignorance. Fortunately, fully kept away form the violence of the Middle Ages, the Arabic countries protected that legacy. Because of the time, the inexactitude and the confusion, our idea of the Greek's knowledge is quite uncertain. Some discoveries might have been misattributed, and some great scientists could stay in the shadows. One thing is certain; many of those brilliant spirits died believing they understood the universe. That can make us put our knowledge into perspective. What are we really sure about? What if we are totally wrong about our perception of the universe?

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Ancient Chinese Astronomy

When we think of astronomy, we normally tend to think about big, expensive telescopes up in some remote mountains, or maybe the Hubble up high above Earth, looking at the stars. But what most of us don't think of, is astronomy in the ancient word, ancient meaning the pre- industrial world. In the subject of astronomy in the ancient world, one of the biggest players was China.

The first astronomical records made by China date back to about 3000 B.C. They were the first civilization to record an eclipse. This record was done in the year 2136 B.C. China was the only country at the time who separated astrologers from astronomers. The job of the astrologers was to interpret the happenings in the sky as omens, and then use them to advise the emperor. The emperor always consulted with his astrologers before making important decisions. Astronomers were more concerned with making predictions by observing them as regular events. Another discovery that they are famous for is taking note of the supernova that happened in the year A.D. 1054. They called it a 'guest star'; we now know it as the Crab Nebula. They were the only culture other than the Anasazi Indians to record it.

Telling time was a very important part of the Chinese culture. It was even more important to be able to tell time accurately, which the Chinese were able to do. They used the orientation of the Big Dipper relative to the North Star to tell the time of year. By the year 2300 B.C., there started to be sophisticated observatories. By 1279 the Gaocheng observatory was under construction by the famous Chinese astronomer Guo Shoujing. On top of the observatory is a huge sundial, 93 feet long. The oldest remains of an observatory in China date back 4100 years.

The Chinese were incredibly accurate with their calculations. The star map that a man named Shi-Shen made was the most accurate in the world for the next several hundred years. It mapped out 809 stars and 122 constellations. The sundial atop the Gaocheng observatory was used by Guo Shoujing to calculate the time of the year to 365.24 days, a measurement that's within 30 seconds of our modern calculations. Another very important Chinese astronomer was Zu Chongzi. He was a very famous astronomer and mathematician, he was also the first to calculate pi to 7 decimal places, which would be the most accurate number for the next 100 years. He came up with an equation to find out how many times the sun and moon overlap, which he used to successfully predict 4 eclipses over a period of 23 years.

Most people normally consider the ancient astronomy of Europe as being more advanced, and have a more Eurocentric preference for the Greeks, or the Islamic contributions to science, but China is often overlooked. They were actually one of the

leading cultures whose astronomers tried to make their measurements ever more precise. A lot of these calculations remained the most accurate for hundreds of years. They made lots of discoveries, observations, and predictions. A lot of their ideas helped the rest of the world out later, when they were trying to be just as precise.

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Renaissance Astronomy

Before the period called the Renaissance, people were starting to wonder how the universe worked. An example of a few questions they would ask about included: are we the center of the universe? Are we alone in the vast universe? Are stars like our sun? Some of the cultures that did astronomy before the Renaissance were the Greeks, the Romans, and the Egyptians. Before the Renaissance there was the long and brutal Roman Empire, and the long middle ages. During the Roman Empire not many people explored astronomy as much as they did before it. During the Middle Ages people started to forget about the Romans and started to explore science and math more. More people started to believe other things about the universe that were contradictions with religion. The Renaissance started around the year fourteen hundred. During this time most people thought that the Earth was the center of the whole universe. This was true to most people that were religious.

In the year 1473, Copernicus was born. He was really a church official, but he was thinking and testing scientific ideas that would get him killed by the church. His interest in astronomy grew and he devoted a lot of his time to it. He started to think that the Earth moves around the sun, but he thought that this idea would get him punished very badly by the churches. Most churches thought and believed that the Earth was the center of creation, so that meant everything must revolve around God and them. In the year 1530, Copernicus published his paper *De Revolutionibus* that said a few things about his belief in the Earth revolving around the sun. The only reason he did not wait until he died to publish this is George Rheticus a, German math professor convinced him. The reason he

wanted to wait until he was about to die to publish his findings was so that he would not be killed or severely punished by the church. He also wanted to wait until he was dying to publish this because he did not want to witness his work being wrong; he was a perfectionist. He published the rest of his work in the year 1543 (the year he died).

After him a guy named Galileo started using telescopes (he did not invent them) to look the sky. He is famous for bringing telescopes to Europe and using them to look at the sky. After going to college, he became a professor of mathematics. After this is when he started to get into astronomy. He is also very famous for finding the moons of Jupiter. After finding this out, Galileo published papers about the idea of a heliocentric universe. The Catholic Church got mad at him and accused him of being a heretic. He was cleared of the charges for this, but was told to keep quiet about it. Despite this, Galileo kept working and making more discoveries about space, and he published a book about space that supported a heliocentric universe. He was found guilty of heresy in 1633 and was sentenced to life imprisonment. He was then placed under house arrest because of his age. He kept working on things until he died in 1642.

Overall, these people and cultures are really the reason why we have so much knowledge and applications for everything that has to do with our universe. We owe our daily lives too these people who didn't care what other people said and kept pursuing the real truth.

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Ancient Astronomy

Summary

Astronomy is determining the law of stars. We have become very advanced in today's study of astronomy, but would have never made it this far if it wasn't for our background in ancient astronomy. Throughout centuries, different parts of the world have studied and developed knowledge about astronomy. Each culture has a unique philosophy through its findings, but in the end they all assemble together to develop greater skills and discoveries we now know of today. Ancient astronomy from cultures such as the Greek, Chinese, Mesopotamia, Babylonian and Renaissance provided us with astronomical knowledge we now know today.

The Greeks developed a lot of astronomical findings. They were amazing at applying mathematics to the understanding of the universe. Astronomers such as

Pythagoras, Aristotle and Aristarchus all made many contributions to astronomy. Pythagoras figured out ideas of geometry, and also created the idea of a spherical Earth and moon. Aristotle came up with several discoveries and theories. He believed that the sun rotated around the earth. He concluded that the Earth is stationary instead of objects being far away. Aristarchus used trigonometric interpretation to discover the scale of the universe and angular sizes of the universe.

Another contributor to astronomy is China. Ancient Chinese astronomers discovered many objects in the sky. They discovered comets such as Halley's Comet. They also developed a few calendars. One was a lunar calendar, and the other was based on the orbit of Jupiter. This twelve year orbit calendar followed up on the different animals passing the region of Jupiter that year. This is how they have their individual animals of each New Year.

Mesopotamians recorded astronomical discoveries on clay tablets. These clay tablets provided information of observations and calculations of the motions of the planets. Babylonians made advances such as a lunar calendar, which was based on the New moon phase. This calendar derived from the seasons, which made it 12 months with an occasionally 13 added month every year.

Fast forwarding to the Renaissance, we are presented with new and exciting ideas from scientists and astronomers like Nicolaus Copernicus, Galileo and Isaac Newton. Nicolaus proposed a new idea that the sun was the center of the universe, rather than the Earth. While Copernicus' theory was challenged by the world, Galileo supported it with the invention of the telescope. And later, the Copernicus system was proven by Isaac Newton who discovered the law of gravitation between two masses. Knowing the sun was the most massive object in the planetary system, he proposed that the planets would naturally be attracted to and orbit around the sun.

In conclusion, we have come a long way in astronomy. Ancient astronomy is a vital resource to today, tomorrow and future generation. Without it, science would not be the same today.

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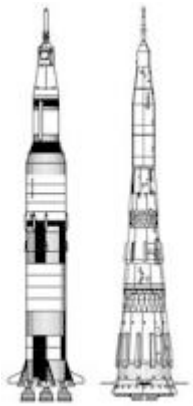
Chapter 2:

Sputnik to Apollo



NASA

Sputnik to Apollo

NASA is the United States Space program. It stands for National Aeronautics and Space Administration and it was created in 1958 by President Eisenhower.

NASA was formed on October 4, 1957, after the USSR launched Sputnik because the US felt threatened and alarmed by the perceived threat to national security. This era in U.S. history became known as the Sputnik crisis because the government and the military were paranoid that the Soviet Union was going to use outer space to attack the US. On July 29, 1958, the National Aeronautics and Space Act was signed. It was the document that established NASA. At first, NASA started out with a 100 million dollar budget, and 8,000 employees. Now, it has over 18,000 employees and a budget of about 17 billion. A significant contributor to NASA's entry into the Space Race with the Soviet Union was the technology from the German rocket program. The designs helped the U.S. greatly because they did not have enough time to design and make all their own technology.

From the very beginning, NASA concentrated on manned programs. It all started with the X-15 rocket plane which flew from 1959–68. It was used to test out designs for jet engines and also space suits for astronauts. Its highest altitude was 107.96 km above Earth.

NASA's next big project was Project Mercury. The goal of Mercury was to get a human in space before the Soviet Union. Even though the Soviet Union beat the U.S. by about a month, getting an American man in space was still a big achievement for the U.S. and NASA. Mercury ran from 1959–63 and was the biggest contributor for getting a man in space first. The first seven astronauts were selected among candidates from the Navy,

Air Force and Marine test pilot programs, and on May 5, 1961, Alan Shepard became the first American in space. John Glen was the first American to be launched into orbit on February 20, 1962. He did 3 orbits around the earth.

After Mercury came Project Gemini. The goals of Gemini were to increase Mercury spacecraft capabilities to long-duration flights, and to develop space rendezvous techniques, as well as precision Earth landing.(1) Project Gemini ran from 1961–66. Gemini was a two-man program, and it played a big role in growing the Mercury spacecraft capabilities. Gus Grissom and John Young flew the first manned Gemini flight, Gemini 3, on March 23, 1965. Nine missions followed from 1965 to 1966.

Finally, came project Apollo. Apollo's goal was to get a man on the moon! Apollo used Saturn rockets as launch vehicles, which were far bigger than the rockets built for all the other projects. In 1969, Apollo 11 became the first spacecraft to land on the moon, but there were four missions before it in which they practiced maneuvers for the moon landing. Neil Armstrong was the first to take a step on the lunar surface, and he was followed by Buzz Aldrin. After Apollo 11, five Apollo missions landed astronauts on the Moon, with the last landing on December 1972. Project Apollo ran from 1961–72 and was the most expensive project; in fact it would have cost nearly 202 billion dollars in today's money. It also got the first Americans to the moon!

NASA played a massive role in getting America to space and completing many space missions. NASA still thrives today, with plans to expand the limits of space exploration. After all, as Neil Armstrong once said on the moon, "That's one small step for man, one giant leap for mankind."

Haydn Brooke
7th Grade

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“Shaken, not stirred”

Throughout history and its wars, spying and espionage have made huge contributions to the interactions and successes or failures of the warring nations. One of the greatest examples of advanced spying was in the Cold War. The Cold War was between the United States and the United Soviet Socialist Republic. During the Cold War, spying was rapidly modernized by the start of innovations of space exploration. The Cold War sparked the space race because of fears of the times, as well as natural human desires for superiority. During the Cold War, the U.S and the USSR both wanted to be heroes, and as a result, the U.S and the USSR made great sacrifices to stimulate scientific research and ultimately, expand conflicts into space.

The Cold War began in 1947 and did not end until 1991. The Cold War was named the Cold War because both the United States and the USSR had nuclear weapons and therefore had the power to completely detonate the entirety of the opposing nation at any moment. However, the two nations never actually participated in any direct combat. Instead, during the Cold War, the two nations participated in psychological warfare. (Wikipedia.org/wiki/Cold_war). The space race began in 1957, when the two nations focused their attention on firsts in space exploration and the competition quickly escalated. As William E. Burrows said, “The cold war would become the great engine, the supreme catalyst, that sent rockets and their cargoes far above Earth and worlds away. If Tsiolkovsky, Oberth, Goddard, and others were the fathers of rocketry, the competition between capitalism and communism was its midwife.” (Wikipedia.org/wiki/Cold_war)

Due to the fact that both the United State and the USSR were at all times preparing to fight one another, the spying on both sides was aimed at finding out the opposing sides’ intentions in terms of military and technological innovations. To obtain the opposing side’s intentions, the United State and the Soviet Union had many covert agencies such as the CIA, the KGB or MI6. These agencies relied on spies, similar to James Bond, for example. Although fictional and rather extreme, his work does reflect parts of the ideas being used during the Cold War. Spies were extremely important in the acquiring of information throughout the whole Cold War.

Along with spying with human spies, there was another form of gaining information. This was satellite surveillance. Satellites provided a new view on the world and also allowed the Soviets and the Americans to spy on one another from miles and miles above earth’s surface. The world’s interest in satellites began when the Soviets sent up the Sputnik 1. In 1957, Sputnik 2 was launched, carrying with it, the first living passenger, a dog by the name of Laika. The Soviets were testing whether or not living beings could survive in space. The fact that Laika survived would greatly influence the Soviets work to get a human into space. By 1955, the United States announced they would be launching satellites by spring of 1958, and on January 31, 1958 the first American satellite, the Explorer 1, was launched. The United States and the USSR were able to survey each other by having the satellites take photos from space which would then be transmitted to the ground and inspected.

The Cold War played a huge role in the development of innovations in space. Without the Cold War there would not have been as much incentive to beat the other

nation into space. The fear of the war triggered people's instincts, in the sight of danger, to be heroes. While Americans take credit for being the first to have a man walk on the moon, it is also quite important not to forget that it was, in fact, the Soviets to be the first to make it into space itself. I believe it is safe to say that both the United States and the USSR came out partial heroes, as our technologies in space would not be nearly as advanced had it not been for the competition.

Grace Strelich

Grade 10

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Why the Moon?

When the Soviets and the US first began looking at the moon as a goal, for them it seemed fairly easy, but various complications pushed them to have to work much harder than they ever expected. The moon was chosen as the new focus, not because it was easy, but since the moon was conveniently in the Earth's orbit, it was the closest natural object to aim for. One of the most pivotal events of the 20th Century occurred when the first human landed on the moon in 1969.

The physical exploration of the moon began when the Soviet Union sent up their unmanned space probe, Luna 2, the first spacecraft to ever reach the moon's surface. It landed very hard, on September 14, 1959. Luna 3 was sent in October that same year, and first captured photographs of the far side of the moon. Importantly, these pictures showed that the far side and near side of the moon are much different, showing a mountainous terrain with only two dark regions.

In an effort to compete with the successes of the Soviet Union, US President John F. Kennedy then proposed the national goal of landing a man on the moon. While speaking to Congress on May 25, 1961, he said,

> First I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more important for the long range exploration of space.

The Soviets remained in the lead in this race for quite some time longer. They continued with their Luna launches, and Luna 9 launched in 1966 achieved a soft landing

on the lunar surface and transmitted pictures from the moon's surface to Earth, as opposed to Luna 2 which landed hard on the lunar surface. This landing also proved that the lunar surface could support the weight of a lander and that an object wouldn't sink into a loose layer of dust as previously predicted. Another success the Soviets had was Luna 10, the first spacecraft to successfully orbit the moon and the first human-made object to orbit any body beyond the Earth.

While the Soviet Union was seeing great success in its Luna program, the US started its own program to study the moon, naming it "Ranger." The US finally launched their first spacecraft to the moon, Ranger 4 on April 23, 1962, which was unfortunately unsuccessful, slamming into the far side of the moon and returning no scientific data to Earth. After several more attempts and failures, Ranger 7, launched in 1964, was somewhat more successful. It was able to capture about 4,000 pictures before it crashed into the moon's surface. The Ranger program continued having difficulties with landing softly on the moon, and it wasn't until Surveyor 1 was launched by the NASA, that the first spacecraft from the US made a controlled landing on the lunar surface. Surveyor also carried cameras and samplers which analyzed the nature of lunar rock and dirt. Most importantly though, it demonstrated the necessary technology to achieve landing and also provide data on the compatibility for the upcoming Apollo missions.

The US slowly began to get ahead of the Soviets in the race to the moon, first with their lunar orbiters which photographed 99% of the Moon's surface when Luna 3 was only able to photograph the far side of the moon, and then finally taking a huge step forward with the Apollo missions launched by NASA. Unfortunately, Apollo 1 was unsuccessful, and three lives were lost as a result of an accidental fire in January of 1967. But on December 21, 1968 the crew of Apollo 8 became the first humans to ever enter lunar orbit and have the opportunity to see "home" from a completely new perspective. For the first time in history humans were able to see not just an uninspiring jigsaw puzzle of states and countries, but rather a whole planet uninterrupted by boundaries. The most tremendous mission was taken by NASA's Apollo 11, launched in July, 1969. The lucky two on board were Commander Neil Armstrong and Edwin "Buzz" Aldrin. Neil Armstrong became the first human being to ever walk on the surface of the moon, uttering his famous statement, "This is one small step for a man, one giant leap for mankind." At this point the US was significantly ahead of the Soviet Union in the space race. The Apollo program continued to send men to the moon until December 1972 on Apollo 17 and to date Eugene Cernan is the last man to walk on the moon.

From the mid 1960's up to the 1970's alone there were 65 moon landings, which suddenly stopped in 1976, when it was decided that it was time for a new focus and goal. The race to the moon was one that took a while, but once the moon was reached by humans it was more than just rewarding. The moon exploration was definitely worth it, because we not only got a new perspective on Earth, but NASA was able to prove itself in the end, and the US surpassed the Soviet Union. The long awaited landing on the moon will always be remembered and NASA's success will live on for generations to come.

"The important achievement of Apollo was demonstrating that humanity is not forever chained to this planet and our visions go rather further than that and our opportunities are unlimited"- Neil Armstrong

Odalys Gonzalez
Grade 10

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JFK and LBJ: The Space Race

When Russia sent the Sputnik, the first spacecraft into space, the space race began. Because the Soviets had gotten someone to the moon, Americans realized they needed to step up and get into space. With the power of President John F. Kennedy, Lyndon B. Johnson, and the support of the American citizens, the space program continued to be successful and eventually achieved the goal of getting a man to the moon.

In 1958, during the presidency of Eisenhower, he signed the National Aeronautics and Space Act, which established NASA. NASA began with 8,000 employees, and had a starting budget of one hundred million dollars. They also started with three large research laboratories and two small ones. From these starting points, NASA continued to grow bigger. This was only the beginning.

When President Kennedy came into office in 1961, he had an intense passion for the space program. He wanted to keep the space program going and he wanted to re-vamp it. On May 25th, 1961, President Kennedy stood before Congress to explain the need for further development of the space program. He asked for seven to nine billion dollars in order to continue the development of the space program. His goal was to land the first man on to the moon. He stated that the country needed to devote itself to achieving the goal within a decade. At first, many were skeptical of the NASA program and its ability to execute space exploration. Their opinions changed however, when Alan Shepard and Gus Grissom were the first Americans to go into space. The successes continued. On February 20th, 1962, John Glenn Jr., became the first American to orbit the Earth. Under the Kennedy Administration, many more missions were achieved and each lasted longer then the one before.

When the assassination of JFK happened, Vice-President Lyndon B. Johnson became President. He took over the reins of the space program. He continued to produce successful missions such as Project Gemini. During his presidency, the Apollo Program was created. The main goal of the Apollo Program was to get astronauts to the moon safely and ensure a safe return back to Earth. The Apollo Program although successful, did have a setback. In 1967, Apollo 1 exploded killing the entire engine crew. This was a huge setback for both NASA and LBJ. Many people started to doubt both NASA and the Apollo Program. Throughout the setback and the controversy surrounding NASA and the Apollo Program, President Johnson stayed loyal to the program and stood by its side. On July 11th, 1969, about six years after the assassination of President Kennedy, the goal he set some eight years prior, was achieved. Neil Armstrong, Buzz Aldrin, and Michael Collins were the first Americans, as well as the first humans, to safely land on the moon.

Throughout the 1960's, the space program flourished. Although there were some setbacks, the programs, such as the Apollo Program, reached to goals that were set for them. Under the Presidencies of Kennedy and Johnson, the programs achieved greatness. Setbacks, such as Apollo 1, caused there to be some doubt, but in the end, the passion of President Kennedy, the loyalty of President Johnson, and the support of the American people, pushed the development of space program, causing great achievements throughout the years. Our country reached new heights, and those heights got us to the moon.

Matthew Nunez
Grade 11

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From Sputnik to Apollo: The Accidents

A total of 530 people from 38 different countries have been into space. 512 of these have been successful. However, there have been 18 casualties that have occurred in human spaceflight. Four of these occurred between the launch of Sputnik in 1957 and the final Apollo launch, Apollo 17 in 1972. Surprisingly, all of the in-space flight casualties in this time period occurred on the side of the Soviet Union. The first of these was Vladimir Komarov, aboard Soyuz I (1). The one-day mission of the first Soyuz had been plagued by a series of mishaps with the testing new spacecraft type. These, along with with its parachute not opening properly after atmospheric reentry, resulted in Komarov being killed when the capsule hit the ground at high speed. The crash site is about 170 miles east-southeast of Orenburg in Russia. There is a memorial monument in a small roadside park. It is a black column with a bust depicting Komarov.

The only other in-space flight causality between Sputnik and Apollo 17 was the Soyuz XI (11). They had been staying at the space station Salyut I (1) for three weeks, when a cabin vent valve accidentally opened at the service module separation. The recovery team found all three of the crew dead. Technically these are the only *in space* (above 60 miles) casualties to this year. Their capsule had landed about 55 miles southwest of Karazhal, Karagandy, Kazakhstan. In a small circular fenced area at the site is a memorial monument in the form of a three-sided metallic column. Near the top of the column on each side is the engraved image of the face of a crew member set into a stylized triangle.

The last two casualties were the only in-flight casualties in the Sputnik - Apollo era, but there were quite a few casualties in training and on/near the ground.

The first ever space casualty was the death of Valentin Bondarenko when he was training in a low-pressure chamber with a pure oxygen atmosphere. He dropped an alcohol soaked cloth onto an electric hotplate. The oxygen ignited, and fire engulfed the entire chamber. Bondarenko suffered third degree burns over most of his body and face, and he later died of his burns after being hospitalized. Bondarenko's death was covered up by the Soviet government; word of his death only reached the West in 1986. It has been speculated that knowledge of Bondarenko's death might have led to changes in design and protocol that could have prevented the Apollo 1 fire.

Another casualty from a training mission was Theodore Freeman of the US in 1964. Freeman was on landing approach to Ellington Air Force Base near Houston, Texas, when he ultimately died due to a goose smashing into the left side of the cockpit canopy of his T-38 jet trainer. Flying shards of Plexiglas entered the engine intake and caused both engines to flame out. The astronaut tried to continue the landing approach with broken engines, and then attempted to steer the troubled aircraft away from buildings at Ellington and toward an open field, when the aircraft could not make it to the runway. Freeman ejected from the aircraft, but was too close to the ground at that point for his parachute to open correctly. Freeman was found, dead, about 90 meters from the crashed aircraft.

Openness among countries in regard to their accidents could have prevented casualties in other space flights. Certain countries have kept themselves shrouded in secrecy, and that has led to the same mistakes being made multiple times.

Ethan Steiner
Grade 8

The Real Heroes of Space

You may know about Neil Armstrong and his famous moonwalk, but you may not have realized that, in order for him to get to the moon safely, animals' lives were sacrificed for studies. The first animals to go to space were small animals, then monkeys, and later, larger animals such as dogs. Animals were sent not only to see how they responded in space, but also to find out about space and how to survive in space.

The first living organisms to go to space were not a dog named Laika or a monkey named Albert, but fruit flies. In 1946, fruit flies were sent up 106 miles and came down safely and survived. The fruit flies were part of the White Sands, New Mexico project to study the effects of high-altitude radiation.

A year later the Americans launched a rhesus monkey to help the scientists find out how larger animals would withstand space conditions. Unfortunately, Albert 1 (the rhesus monkey) did not survive due to close quarters and the re-entry parachute not performing correctly. This taught scientists that they needed to add more space for the animals (and later humans) so that the animals would not suffocate. This would mean that the scientists needed to redesign the parachute. Also many more monkeys were sent up as part of the Albert project, but each one failed for the monkey (mostly because of the parachute), but taught the scientists new things.

As well as monkeys, mice were launched into space. In 1951, the U.S. sent up a monkey (Yorick) and eleven mice. These animals were the first U.S. animals to come back alive from near space to Earth. Yorick and the eleven mice made it to 45 miles; infuriatingly, they did not make it to space. (Space is about 50 miles up.) In 1952, two mice (Mildred and Albart) and two monkeys (Patricia and Mike) went up to 36 miles and came back alive. After they came back, Patricia and Mike lived the rest of their lives in Washington D.C., at the National Zoological Park.

In 1957, a very important thing happened for mankind and space. Sputnik 1 was launched by the U.S.S.R. and successfully went into orbit. A month after Sputnik 1 was launched, Sputnik 1 was celebrated with the launch of Sputnik 2. Sputnik 2 had a female

dog named Laika in the capsule. Laika (which means barker in Russian) was originally named Kudryauka (little curly), but the American press nicknamed her Muttnik. She was three years old, weighed 13 pounds, and was a stray. The Russians preferred stray dogs because they believed that they were tougher. Unfortunately for Laika, being tougher did not help, and again bad luck fell upon the animals and the scientists when Laika did not make it back to Earth alive. People believe that Laika had lived for four days, but in 2002 scientists found that she had only lived for a couple of hours due to heat and panic. Laika's death showed scientists that they needed more heat insulation in the capsule design.

All these animal experiments led the way for humans in space, the moonwalk, and the International Space Station. The animal experiments showed how weightlessness works, explored different space effects, and adaptation. After Sputnik 2 and a couple more space flights, animal experiments in space decreased. Some of the dogs that followed Laika were Bars, Lisichka, Belka, Strelka, Pchelka, Mushka, Damka, Drasavka, Chernushka, Zvezdochka, Verterok, or Verterok, and Ugolyok or Ugolek. Some of these dogs died in space flight but all the dogs were very important.

In 1961, the first non-human primate went into orbit, a chimpanzee named Enos from the U.S. The chimpanzee lived and from that success, a year later, John Glenn was the first human to orbit Earth. In 1963, the first cat was launched. The cat was a black and white cat whose name was either Felicette or Felix. (They don't know if it was a female or male.) The cat lived and made it to 120 miles up.

Many animals were tested to see how they would cope with space. They ranged from all different sizes and intellects. There have been many animals in space, and they were all very important, but what really started the space race was Laika, whose sacrifice transformed space exploration for mankind. There were many animals whose lives were lost, and yet we do not know all of their names or care about them. All the animals that were tested for space, or went to space, are the real heroes of space.

Jade Mueller-Galbraith
Grade 9

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The Soviets Win
(Sorry, America)

Since Peter the Great, Russia has been a worldwide power. Russia has been a center for trade, politics, and intellectuals. It has produced fascinating people such as Dmitri Mendeleev, creator of the first periodic table of elements, and Leo Tolstoy, author of *War and Peace.* by the 20th Century, Russia was just as powerful as ever and had defeated countless armies who had tried to penetrate its borders. Russia proved itself once more to the world when it sent the first artificial satellite into orbit and, from there, took the lead in the space race. Americans are narcissistic in that we always talk about all the fantastic things we did during the space race, but in reality Russia had more firsts in space exploration than Americans care to acknowledge.

The first attempt at sending something into space was when the Germans sent up their V-2 rocket, the most powerful rocket ever created. After this, in Russia, Stalin started the Rocket Development Program (RDP), which encouraged the idea of orbiting satellites. The first idea for a Soviet satellite was developed in the national, top-secret Nll-4 Research Institute. Mikhail Tikhonravov was appointed head of the project. By 1948, Tikhonravov determined that it was possible to connect several rockets, giving a large craft enough power to get into orbit. He presented his idea to many people but received mixed reactions. In fact, his idea did not get recognition until Stalin died and Nikita Krushchev took over the leadership of the Soviet Union. To convince the Soviets that the satellite was a necessary project, Tikhonravov used the argument that was sure to get him funds and support. He told them that the Americans were about to send an orbiter into space. The Minister of Armed Forces approved his proposal and, on May 25, 1954, had full political and financial support.

Sputnik is known as the Simplest Satellite. With a diameter of only 580 millimeters, the satellite was barely larger than a beach ball. The satellite blasted off on October 4, 1957. The Sputnik team heard from the satellite for about two minutes once it had began to orbit. This event marked the start of the space race between the U.S. and U.S.S.R.

The Soviet Union was a huge leader in the space race; they earned a lot of firsts, including the first major space-related catastrophe in 1960. The Nedelin Catastrophe is not very well known due to the government keeping it a secret for nearly twenty years. The Soviets were in the process of launching their first R-16 rocket when an unfortunate series of events led to the explosion of the rocket on the launch pad and the deaths of nearly 200 people. On October 24, 1960, the second stage engine came to life 30 minutes before scheduled launch time and burst through the fuel tank below, creating a fireball 120 meters in diameter. Many people were instantly incinerated, others died seconds later because of toxic gas poisoning.

In 1961, the Russians had another first by sending the first man into orbit. Yuri Gagarin was chosen out of 20 of the Soviet Union's first trained Cosmonauts. Gagarin flew in the Vostok-1, which was very cramped for space. Many people thought Gagarin

was sure to die either upon lift off or in reentry, but to many people's surprise, the mission was a complete success. Three years after Gagarin's legendary flight, the Soviets launched Vostok-6, containing Valentina Tereshkova, making her the first woman in space. During her three-day orbit, she took countless tests to see how the female body reacts to space flight.

Many people have forgotten how incredibly important the Soviet Union was in the space race. Although the U.S. was the first country to put a man on the moon, the Soviets were the first to put a satellite in orbit, a man in orbit, and then later the first woman in space. During the space race the soviets challenged the U.S. to extend our knowledge to the edge and reach goals higher than the atmosphere.

Lia Millar
Grade 10

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Space Race
Summary

From Sputnik to Apollo, in space history is one of the most important eras because it was the first outer Earth space exploration in human history. It is an era where technology grew immensely and laid foundations for technology of the future. Our group covered the beginning of space programs from the Soviet Union and the United States. Without this rivalry to get to space during the cold war, space travel might not have progressed so rapidly. In the end, it took two countries to make space travel happen and allow the human race to reach the heavens.

On October 4, 1997, the Soviet Union created the first satellite that successfully orbited the Earth. It proved that humans had the power to reach space. Since it took place during the cold war, many Americans feared that the Soviet Union could launch missiles to the United States. In response to the Soviet Union's launch of Sputnik, the U.S. developed a program that would help the U.S. compete with the Soviets. NASA was created in 1958 by President Dwight D. Eisenhower.

The next goal in both countries' agendas was to put a man into orbit. Both countries had to take steps to develop a rocket, which could support life in space. The Russians first sent fruit flies and stray dogs into near space. Some perished and some survived. Laika, a dog that was sent in Sputnik II, made scientist and engineers realize that the capsules needed more insulation. The next animals used were primates. In 1961 the U.S. sent, Enos, the first chimpanzee into orbit. NASA, however, was a step behind, as the Soviets where first to send a man into orbit that same year. The U.S. was down 2-0 in the space race and was in need of a leader who was willing to do the impossible.

John F. Kennedy filled the role of a leader the U.S. needed to expand the space program and make it a priority in the U.S. government's agenda. His famous speech in which he announced that the U.S. would put a man on the moon is one the greatest speeches given by a President. Unfortunately for Kennedy, he was not able to see his dream come true as he was assassinated in Dallas, Texas, on November 22, 1963. His Vice President, Lyndon B. Johnson, however, would not allow his dream of a man on the moon to die with him. He continued to fund the space program, which allowed NASA to put men on the moon.

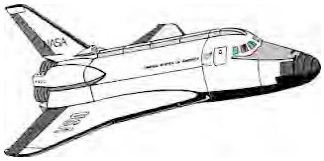
Astronauts became instant heroes for what they had achieved. In some cases the heroes were not even human. After the testing of animals and the effects rockets and space had on their bodies later, Yuri Gagarin and John Glenn where the first men to go into orbit, which proved humans can survive outside of the Earth's atmosphere. Neil Armstrong and Edwin "Buzz" Aldrin were the national heroes that are probably the most famous of all the heroes for landing on the moon. But these achievements were not easily achieved as many accidents happened while trying to reach new heights. Many tragedies occurred, including the death of animals and humans. They should also be remembered as heroes for testing rockets and space capsules.

In the end, the space race was worth it. It allowed advancements in technology not only in rocket building but also in electronics for instance by building the first computer, not as powerful as now but the technology laid the foundations for many electronics we are now dependent upon. The space race proved that the human race could achieve many things and soar to great heights. It proved that the sky, in fact, is not the limit, and that we are capable of going beyond.

Isaac Macario
Grade 12
Group Leader

Chapter 3

The Space Shuttle Program



Pollution into the Environment

The shuttle program started in the year 1981. NASA started launching shuttles attached to rockets. During the shuttle program a lot of pollution was released into the environment. Some ways pollution was distributed into the environment was when they were launched into space, pollution in the stratosphere and atmosphere, and chemicals left from previous launches in the ground. There are many ways that pollution was distributed into the environment. In this essay I will talk about NASA's shuttle program distributing pollution into the environment.

One way pollution was released in the environment was when the shuttle is launched. Every time a shuttle is launched, the solid rocket boosters let out a lot of fluids and liquids, leaving clouds of smoke full of harmful chemicals in the environment. This is why solid rocket boosters are criticized by environmentalists. When a shuttle is launched it releases up to 28 tons of carbon dioxide. The "smoke" that comes out of the rocket boosters is mostly steam. The solid rocket boosters are what give out toxic particles when shuttles launch. When a shuttle goes up, it leaves harsh chemicals behind. The result of this is that people cannot approach the launch pad that has been used for a couple of hours. Shuttle launches are just one way that pollution can get into the environment.

Pollution is also distributed into the environment when the shuttle is going up into the stratosphere. A big amount of chlorine in the stratosphere attacks the ozone layer and causes it to break down. An estimate of the amount of chlorine in the stratosphere is 300 million kg. The amount of chlorine made by the space shuttles and other rockets using similar solid propellants is actually quite small and has a miniscule effect on the ozone layer. One of the byproducts of the chemical reactions as the solid propellants are burned is chlorine. Atmosphere pollution is also another way of pollution. Every time a shuttle goes up the solid fuel rocket boosters spew many pounds of aluminum dust into the atmosphere. Some of the aluminum never comes down. That means since there have been a lot of shuttle flights there are millions of pounds of aluminum up there blocking radio transmissions and sunlight. This pollution is brought from primeval "explosion." This is atmospheric pollution. Stratosphere and atmosphere pollution are just other ways of pollution.

Another way pollution is released into the environment is when they launch and they leave harsh chemicals in the ground. After the shuttle program ended, they found chemicals under the ground from previous launches at the Kennedy space center. The people who work at the Kennedy Space Center want them to clean up the chemicals under the ground. This causes pollution because the chemicals under the ground can kill plants

and, therefore nature, because the plants roots are under ground and those chemicals can reach the roots and kill the plants. This is not the only reason but because the chemicals can harm people as well. It will cost up to $96 million dollars to clean up all the chemicals in the next 30 years including $6 million dollars in the year 2011. The chemical they found the most of was trichloroethylene, which was used to clean rocket engines. People have already spent a lot of money cleaning up this chemical. There are 267 known contaminated sites at the Kennedy Space Center, but only 141 have been cleaned up. Chemicals under the ground that cause pollution is just only one other way pollution is distributed into the environment.

Space shuttles cause pollution into the environment in many ways. One way is, when the space shuttle go up, they let out a lot of fluids that harm the planet. Another way is the pollution in the stratosphere and the atmosphere where there are a lot of chlorine and aluminum up there that can block radio transmissions and sunlight. One last way is chemicals left behind under the ground. This will cost a lot of money to clean up and will take a long time to clean up all those left over chemicals that are killing plants. But there are many more other ways space shuttles distribute pollution into the environment. Overall, space shuttles do cause a lot of pollution in the environment that causes harm to the planet and living things.

Daisy Gonzalez
Grade 7

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The Shuttles

Challenger:

The shuttle Challenger tragedy had an impact on the states. The challenger mission was delayed many times before the actual launch. A hardware interface module in the launch processing system failed during liquid hydrogen tanking procedures which caused an o-ring to burn and dissolve by the hot propellant gasses. There was teacher on board. She had been the winner of the Teacher in Space Program. The mission was to repair a solar satellite. A researcher by the name of Richard Feynman researched why there was a disaster. What NASA said in a binder of papers Richard Feynman said in one page. The Challenger's mission number is STS-51-L. The shuttle was built by Rockwell International's Space Transport System Division in Downy, California. It had accomplished nine flights before burning up seventy three seconds into flight. It grounded the Shuttle Program for two and a half years. Then there was the launch of Space Shuttle Discovery 1988. This shuttle was replaced by Shuttle Endeavor. The Challenger had deployed ten satellites, orbited the earth 995 times, and had ten flights.

Columbia:

There was a shuttle disaster that NASA ignored and that cost the lives of seven people. This happened when foam from the top struck the wing and put a hole in it. On reentry the wing was cut off from the heat, and the heat got inside and tore it a part. This happened on February 1, 2003. The mission was to do microgravity research. It was named after a small sail boat. The parts were spread from Texas to Louisiana. The thermal protection was blown off. A rescue mission was possible using the Atlantis. The Columbia grounded the Shuttle Program for two years.

What has changed:

Now when the Space Shuttle is in orbit near the ISS, the crew will visually inspect the shuttle. NASA also looks at all the video at the launch site to see if any damage had occurred during launch. There are also many more inspectors to check and recheck the parts so that there isn't the slightest chance of error.

Wyatt Taylor
Grade 7

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The Cons of the Space Shuttle Program

The Space Shuttle Program had many, many benefits. Some people think that the cons didn't outweigh them. The Space Shuttle Program was extremely expensive and had the most total deaths of any space program in history. On top of that, it, in general, failed to do what its original intent had been - making space easily accessible for a reasonable price.

NASA had originally declared the price per launch to be 450 million dollars and 18,000 dollars per kilogram to LEO (a.k.a low earth orbit). The cost seemed to sky rocket up through the years. At the end of the Space Shuttle Program's long run, it hit 1.5 billion dollars per launch and 60,000 dollars per kilogram. The total coast of the entire space program is roughly around 192 billion dollars. In comparison, the Russian program, with its Proton Expendable Launchers, cost only about 110 million dollars and about 5,000 dollars per kilogram.

Taking a fight on the Space Shuttle, however exciting it could be, wasn't exactly the safest thing a person could do. Out of a total of five Space Shuttle vehicles, a whopping two if them crashed. The Space Shuttles had a forty percent vehicular failure rate and a flight failure rate of 1.5 percent. Imagine going on an airplane, for example, knowing that there was a forty percent chance that it would crash. The failure rate of the Space Shuttles would've permanent grounded any other space craft. The Apollo missions, both Gemini and Mercury, had no mission failures.

NASA had promised far more then they could give in order to obtain the funds needed to run the project. They talked about a launch rate that was supposed to be fifty-five launches per year. Then, a few years later, they knocked it down to twenty-four and then only twelve per year. Then, in the year of 1985, it was bumped down to nine. That means that NASA overestimated their launch rate by around eighty-three percent. On top of that, NASA seemed to be requiring more money for even fewer flights.

The Space Shuttle program had promised an easy and relatively cheap way to access space, but was neither. The final costs were high and death toll heavy. Some people think the money for the Space Shuttle Program could've been put to better use, like funding further Apollo missions. Perhaps by now we could've been on different planets if that had been the case.

Nichole Francia
Grade 10

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The Cost of the Shuttle Program

In 1972, NASA took a great leap forward. Just 3 years after the first manned Apollo flight, NASA had come up with a newer, cheaper, and more convenient way of traveling to space. This new technology was called the Space Shuttle It looked like a modified airplane and could be used many times, not just a one-flight machine, saving money for NASA. It wasn't known if this new technology would cost more than the Apollo program and estimates started at 7.95 billion dollars for the Space Shuttle Program. This new technology brought out major controversy and many did not think the Space Shuttles would be safe. Also the amount of money being put into this program from the government did not seem right to many Americans.

Every Space Shuttle flight could cost millions of dollars, and the fact that they wanted to reach almost 24 launches a year would mean the cost of this program could be outstandingly large. They estimated that each flight would cost approximately 9.3 million dollars and that each payload could cost up to around 118 dollars per pound, and later in 2011, it cost 635 dollars per pound. Each shuttle had a 65,000 pound limit and a limit of 50 launches per year. As cost for materials went up and the economy dropped, estimates went up to 450 million dollars per flight, but in today's money, that would be over 1 billion dollars. You can find the average of the launch costs by dividing the total cost of the Space Shuttle Program by the number of flights and you get about 1.5 billion dollars.

NASA allocated 30% in budget by 2005, which was 5 billion dollars all together toward Shuttle flights. Because of the Columbia disaster in 2003, there were only three flights between 2004 and 2006, but NASA still managed to spend 13 billion in this time. In 2009 NASA's budget allowed them 2.98 billion dollars. Program integration cost them 490 million dollars and 1.3 billion dollars toward land operations. They spent 1.46 billion dollars towards flight hardware (which included repair of the orbiters and external fuel tanks).

NASA also owned 12 billion dollars worth of equipment such as Crawler-Transporters (mobile launcher platform), Shuttle carrier aircraft (modified Bowing 747) and The Crew Transport Vehicle (a modified airport jet bridge). They also occupied 654 facilities and employed 5,000 people. The facilities related to The Shuttle Program made up a quarter of NASA's spending. Astronauts' suits cost 13 to16 million dollars each but were reused. The total fuel cost for each flight was around 200,000 dollars. Astronauts would face death every mission but beginners were only paid 65,000 dollars a year and veterans were paid around 100,000.

The total cost of the Space Shuttle Program has been debated a lot but, adjusted for inflation, it can be narrowed down to about 196 billion dollars but with recurring and

nonrecurring costs, the program could be different, but this is not available. Spending this much money on the Space Shuttle Program to many people was ridiculous. Over a span of only 30 years spending almost 200 billion dollars is a very expensive project. The fact that, in just one launch, they could spend 1.5 billion dollars made many people angry because there were many other things people considered much more important.

Bronson Whitney
Grade 9

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JeremynovationNewsDaily Senior Writer Date: 11 April 2011 Time: 03:47 PM ET

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Origin of the Space Shuttle

When the U.S. Space Program first started launching rockets, it was very inefficient and the government spent a lot of money on traveling to low earth orbit, a place where we had visited many times before and knew almost everything we needed to know about. The Space Program was so inefficient that even the president started to look for new ways of traveling to space. Nixon was looking for a semi-reusable spacecraft that could travel to space, be there for some time, and be able to land in one piece back on Earth. He had most of NASA working on this new idea for space travel. Everyone had his or her own ideas of how it should look, take off and land. When NASA had their mind set on one design, they had a series of tests in small and large scale. They soon started to test if the new Space Shuttle to see if it could land on its own with such small wings and no engine for landing. They had to glide into orbit and land with no engine. Powered flight was reserved for the launch into space and moving in orbit. Initial tests were conducted by towing the Space Shuttle on the back of a 747 and releasing it in air where a test pilot would then take control. It was a success and it landed safely.

Once they thought they had the Space Shuttle mastered, NASA would start to send large amounts of cargo. They sent an enormous telescope for scientists on earth to use, called the Hubble Space Telescope, which weighed 24,500 pounds and was put in space on April 24, 1990. NASA would also send teams of scientists up to space to research

everything NASA wanted to know but couldn't be done on earth. NASA also had a program for sending a teacher to space. Christa McAuliffe had been chosen to go to space on the seven-crew mission on the Challenger Space Shuttle which exploded on takeoff. But soon after, Barbara Morgan, who was Christa's backup, was able to make it to space and return safely.

So over all, the Space Shuttle has been successful in my eyes not because of the amount of people traveling to space on successful flights but because of the amount of material delivered and data gathered about space.

Francis Brand
Grade 10

Missed Opportunities of the Space Shuttle

A lot of people believe that the Space Shuttle cost too much and in the end delivered far too little in terms of our advancement in space. Let us consider in the next few paragraphs that this point of view is valid and examine how the Space Shuttle Program may have been a misguided effort. For example, in her article, "Why I'm Not Sorry to See the Space Shuttle End," Sarah Zielinsky argues that the Space Shuttle was over rated and sucked up way too much money, money that could have been better used for other space exploration projects. In "5 Horrifying Facts You Didn't Know about the Space Shuttle," Carol Pinchefsky argues that all the money thrown at the doomed Space Shuttle has actually hindered our progress as far as creating an era of space tourism, when people like you and me can go visit space. It seems the space shuttle never quite lived up to its promise, which was supposed to be less expensive and more convenient access to space.

The Space Shuttle, being a reusable space vehicle, was **supposed** to be cheaper and could **supposedly** be frequently launched. The initial expectation of having weekly launches proved to be a total fantasy, as it took months to turn over a Space Shuttle for its next mission (Zielinski). According to space.com it is estimated the average cost per launch was $1.3 billion. This was more costly than the expendable launchers and failed to reduce the cost of space access (Futron). As Sarah Zielinski points out, the $1.3 billion cost of one shuttle launch, could have funded "3,000 research grants at the National Science Foundation or pay for a big chunk of a spacecraft like *Cassini* that will be producing data for decades." Other NASA projects don't get nearly the funding that the Space Shuttle received, and may in the end prove more valuable to our advancements in space. *Cassini*, for example, has a$3.3 billion price tag (JPL website). The *Juno* project, which is unlocking the secrets beneath Jupiter's clouds, has a $1.1 billion dollar budget (Dunn). *Kepler*, NASA's search for habitable planets costs $600 million ("Kepler: NASA's First Mission Capable of Finding Earth-Size Planets"). And what of the need to solve the problem of climate change on our planet and keep our planet habitable?

NASA's *Calipso* project is making climate observations and improving our ability to predict climate change and study our air (NASA- Calipso Mission Overview).

Perhaps we should have ditched the over-priced shuttle program sooner. With missions such as these less funded mission mentioned above there are no human casualties. Human travel in space has risk and costs us more money and we must consider how often we actually need people out in space to get the information that we are seeking. The Mars Science Laboratory Curiosity Rover costs $2.5 billion (Welsh) – a deal compared to the Shuttle Program. The Space Shuttle was not reliable and had a high rate of failure. "The shuttle killed more people than any other space vehicle in history" (Pinchefsky). The *Challenger* in 1986 killed 7 crewmembers. It was equipped with two satellites and equipment for experiments that were to be carried out during that mission which never happened. Sadly, also on board was the first teacher in space. It was a national tragedy and a giant step back for the program ("Space Shuttle Challenger Disaster"). Later the *Columbia* disaster in 2003 a killed another 7 crewmembers. Pinchefsky remarks with 2 out of 5 shuttles meeting a fiery fate, "This would have grounded any other vehicle permanently."

In "Money Facts: The Space Shuttle Program" it states that according to a survey (taken in 2011) 55% of Americans believe that the shuttle program was money well spent and 58% feel that it was essential that the U.S. remain leaders in space exploration. However, perhaps putting money into the Space Shuttle program was not the way to remain leaders. In "Russia Thriving Again on the Final Frontier," Alan Boyle writes, "…while America's space effort is struggling with safety issues and tight budgets, Russia is now seen as having the world's safest, most cost-effective human spaceflight system." Shuttle-less NASA will now be paying $64 million per astronaut per trip for its own astronauts to hitch a ride to the Space Station on a Russian spacecraft ("Money Facts: The Space Shuttle Program"). At least it's a much cheaper way to get to the Space Station than having a shuttle program. Or maybe as NASA investigates space more with unmanned robots, its future astronauts will get a better deal on a commercial spaceship created by a private sector company. In the web article "NASA Turns to Private Sector for Space Flights" Cliff Sain explains how "private companies are becoming an important part of the space program, and in a few years will be transporting astronauts into space…. Basically, NASA is looking to private companies to get astronauts to and from the International Space Station."

In summary, it seems that our infatuation with the Space Shuttle was really misguided and that the space program missed opportunities to branch out and invest in other projects that could have yielded a better return for the money. Michael Griffin, NASA's head administrator pretty much sums it up when he said six years ago that the shuttle program was a mistake: "While the Apollo programs went to the moon, America spent $196 billion in order to orbit the Earth more than 20,000 times, but never go anywhere new." ("Money Facts: The Space Shuttle Program"). Seems like a waste of money to me for a space program never to go anywhere new.

Natalie Whiting
Grade 7

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The Benefits of the Shuttle

Considering the sheer number of agencies served and programs involved, measuring the cost versus benefit of the U.S. Space Shuttle Program with any degree or accuracy is

nearly impossible. Without a doubt, the work performed aboard the shuttle contributed greatly to science. Perhaps the greatest achievement of the Shuttle Program is the space telescope. Most notably, the Hubble Space Telescope's success would not been possible without the utility provided by the space shuttle to perform repairs to the observatory's Achilles heel: its flawed primary mirror.

- 1990 - Hubble Space Telescope (HST) Deployed
- April 24, 1990: (STS-31) Launch of Shuttle Discovery
- April 25, 1990: Hubble Space Telescope deployed into orbit
- June 25, 1990: Spherical aberration discovered in Hubble's primary mirror
- COSTAR Approved: the creation of a complex packaging of five optical mirror pairs which would rectify the spherical aberration in Hubble's primary mirror

(From NASA)

That happened without any expectation and then everyone felt disappointed about NASA again, after the falling of STS Challenger C. The public and the government started to think that the benefit of the shuttles and the price them cost equal or not. Fortunately NASA found the way to solve this problem and they actually solved another problem which proved that people could repair the machine in the space. Although NASA spent 19 years to solve that problem and they wasted the money and the time, they finally solved that problem. After that, NASA sent other telescopes like WEBB and KEPLER into the space safely and correctly. However this became the point which the public argued about.

Telescopes were only one of the most important parts in the benefit of the shuttles. We have to look through deeply to find the deeper benefit that the space shuttles can make. Every launch of the shuttle is not only a kind of suffering, but also a big step for NASA and the relativity subjects. Firstly outer space science will be improved basically and then many experiments will be done on the space shuttle. Until now, we've got a lot of subjects that were benefited by space shuttles.

Flames are a good example. On Earth, flames have a teardrop shape caused by hot air rising in a gravitational field. On board a spaceship, however, flames break apart into little balls that move around like UFOs. They burn using almost no fuel--something researchers would like to replicate in gas-saving auto engines. One of the experiments on STS-107, called SOFBALL-2, will ignite some flame balls and measure their properties. Scientists hope to learn how they burn and what keeps them lit. **(From NASA Science that can't be done on Earth)**

What we can imagine for science in outer space becomes more and more. We have sent plants' seeds into the outer space and find the new variation. Those new kinds of outer space plants have excellent genes and can transmit them to offspring. New medicines, new

environment for all the plants, new material used for the shuttle could be adapted to the daily life and the new physics principles will be proved.

After that, what I want to talk about are the talented people that NASA and their program trained. When we talk about their dream to children, what they answer most of the time is they will be astronauts or teachers. But to become an astronaut will be hard work to train. What you have to do is to adapt to another environment without air and gravity. And when you are in the space ship, you have to accept the commands as a soldier and do them as quickly as possible. Sometimes what astronauts have to do are some special things quickly to protect them or to finish the task. And after training the astronaut can go to space and finish his dream to explore the mystery of space. Those astronauts will do other things pretty well after training so hard and they will feel it easier to do other things after flying into space. We always call them elites.

So we will ask why the space shuttle can be of so much benefit. That depends on the special environment outer space has. Zero pressure, zero gravity and no air make outer space become the most mysterious and most special place. Because when we only have Earth, this one environment, we have no ability to compare these things to them in the other condition. Like the example I mentioned before, the fire frame was so special in space and what we can totally imagine is that if electricity can make the gravity change, why don't we do it on the Earth. Then the human can copy the zero gravity or even 2 times gravity.

And for a country, territorial air space, territory and territorial waters will be the most important factors to the authority. But now, with the development of the science, humans can explore outer space now. What becomes important will be territorial space. We built the space ship in space and that will become larger and larger. For those three things, humans have strict definitions of that, but not for space. If we have the understanding of space science, we can travel into the space to get the benefits we want. The uniqueness of the zero-gravity vacuum of space is alluring for scientists and romantics alike. It offers both short and long-term possibilities for humankind. Despite its shortcomings, the Space Shuttle Program made the first steps of getting into low Earth orbit accessible to an entire generation.

Allen Zhang
Grade 11
International Student from China

The Space Shuttle Program

Summary

With the fascination of space, the United States Government searched for a new way for space travel. After many successful years of the Apollo missions, the United States designed a new reusable spacecraft that would change and inspire the way humans traveled to space. The Space Shuttle Program lunched its first mission thirty-two years ago on April 12, 1981. The Shuttle was designed to be reusable and to be launched more often. The Shuttle has had both its pros and cons. A benefit of the Shuttle led to the construction of the International Space Station and the Hubble Space Telescope. Also, a lot of experiments have been done because of the transportation the Shuttle provided. There are also some cons about the Shuttle Program. The Shuttle was not always a safe vehicle, leading to two shuttle disasters resulting in deaths of humans. Also being a reusable vehicle, the Shuttle proved to not be as cheap as it was originally planned to be. Looking back at this thirty-year period, we can say the Space Shuttle Program has been a great inspiration for space travel. We can also learn from the mistakes made to move forward in the future.

The Space Shuttle offered many opportunities for exploration. There were a total of 135 mission launches. These launches brought many benefits to NASA, for example the Hubble Space Telescope. An important use for the Shuttle in the construction of the telescope is the reusable spacecraft that could do many trips carrying various parts of the telescope. The Shuttle also helped build the International Space Station, which is one of the most successful accomplishments in space. The Shuttle allowed astronauts to rotate turns in space on a much more regular basis. Without the Shuttle, space travel would have been less often and much more expensive. Early estimates of the cost of the Shuttle were about $9.3 million per launch changed to about $1.5 billion per launch over the thirty-year period. The cost of funding the Shuttle is a little bit over criticized because NASA cut back on the amount of launches some years to prevent overspending. Overall, the benefits the Shuttle brought were more successful than using the non-reusable capsules.

The Shuttle also had its disadvantages. The two big examples are the Challenger and Columbia disasters. These two disasters resulted in the deaths of 14 astronauts. The Shuttle Program is heavily criticized for these accidents. These disasters could have easily been avoided by taking the right precautions. Although these disasters will forever be the dark spot in the shuttle program, the astronauts knew the risk and participated in the Shuttle Program in the name of space exploration. “Great success comes from great sacrifice” and all participants of the Space Shuttle Program knew that. Environmentalists feel the frequency of the launches caused pollution on the ground, stratosphere and atmosphere. There are over two hundred contaminated areas around the Kennedy Space Center and, thousands of kilograms of chlorine and aluminum particles in the atmosphere. Some people feel too little was done with the Space Shuttle. The Shuttle only reached the LEO (Lower Earth Orbit). Could the Shuttle have gone beyond? We will never be able to find out.

Looking back at the thirty year long period of the Space Shuttle, there have been many benefits and disadvantages about the program. There are a lot of people who believe we

could have gotten more bang for our buck. Others believed the Shuttle was dangerous. Some believed it was a success in moving in space travel. I think the missed opportunities and the accomplishments of the Shuttle Program set the table for future space travel.

Esai Macario
Grade 12
Group Leader

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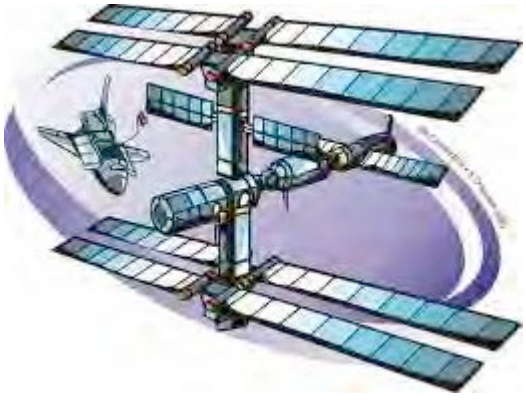
Chapter 4
Space Exploration in the New Century



The International Space Station: A Documentary

The International Space Station (ISS) is unique in that it is the only space station to be a joint project among multiple countries, including America, Russia, Japan, Europe, and Canada. It was sent up in 1998, and has been in orbit since. Since its launch, the ISS has created revolutionary experimental and educational opportunities. It has also

provided a place that astronauts can call home during their expeditions. The ISS will most likely continue to provide these services for many years to come.

Many of the educational opportunities come from calls made to the ISS by schools. Sometimes teachers go up into sub-orbit space flight and demonstrate the effects of zero gravity to their students. However, there are some drawbacks to the calls. For instance, the connection is only stable when the ISS is above the state or continent they are trying to contact, which means that calls can only be 1 to 3 minutes long. Despite that, the ability to go into space does spark some interesting learning opportunities that nothing else can emulate.

The ISS not only provides educational opportunities, but also experimental opportunities, mostly because of the zero gravity environment, the ISS is able to offer. For example, Don Petiti was able to do some pretty cool stuff with water, like giving water contact with air in microgravity. He was also able to demonstrate how food is prepared on the ISS, as well as show how astronauts drink coffee in space. They do this by using a little tube to suck up the liquid coffee.

In order to do all of this, the ISS needs to be a home during expeditions. Astronauts need to adapt to life in space, and the ISS helps with this by providing places to sleep, as well as food, toilets, showers, and everything else needed during the day. In order to sustain the astronauts, food, mostly fruits and vegetables, is brought up to space station. Since the taste of food is diminished in zero gravity environments, extra spices are used in food to make it palatable. Since muscles deteriorate while in space, exercise is highly recommended in order to keep muscles healthy and in top shape. Bones also become weaker in a space environment, due to the fact that skeletons don't weigh anything in zero gravity.

The ISS is a revolutionary space station, one that multiple countries look after. It allows for amazing educational opportunities, great advancements in zero gravity research, and it's a decent home in space. Let's hope that many more discoveries are made on the ISS until it's decommissioned sometime around 2020-2028.

Sam Bernstein
Grade 9

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The Day We Lost Seven Friends

On Saturday, February 1st, 2003, NASA lost the Columbia Space Shuttle with seven astronauts on board. This was the oldest shuttle in the fleet of four, and this was its 113th mission. These seven astronauts were on a 16-day research mission in the Earth's orbit, and were performing experiments in space. This amazing crew conducted more than 80 science experiments, in areas ranging from biology to fluid physics. The disaster, the Space Shuttle's explosion, occurred while returning back into orbit for landing.

The seven people killed in this accident were all very intelligent astronauts, coming from different backgrounds. Commander Rick Husband had a childhood dream of becoming an astronaut. Pilot Willie McCool loved to see "the eyes light up when you talk to kids" about space. Mission Specialist Kalpana Chawla's path to become an astronaut began in Karnal, India. Mission Specialist Laurel Clark felt very lucky to be able to see the Earth from a unique point of view. Mission Specialist David Brown thought of astronauts as movie stars as a child. Payload Specialist Ilan Ramon was the son of a Holocaust survivor, was an Israel Air Force Colonel, and was that nation's first astronaut. Commander Michael Anderson thought it would be great to be an astronaut from very early on.

81.7 seconds after take off, on January 16th, 2003, pieces of insulating foam from the bipod ramp area of the external fuel tank flew off, at about 545 MPH. These small pieces off foam hit the inner, front part of the left wing, damaging the panels of carbon heat shield material. This created a hole, about the size of a bowling ball, which didn't affect the ship in the low air pressure they were flying through at the time. Because this occurred so little time after launching, this break off of the foam was visible to NASA's cameras. NASA scientists did notice the small piece of foam break off, but they didn't think much of it because of its small size. 8.5 minutes after the launch, the orbiter's main engines were shut down.

On February 1st, after a successful 16-day trip in orbit, the Columbia Space Shuttle was returning to Earth. Controllers lost contact with Columbia at 8:59 am, which was about 15 minutes before the expected landing time at the Kennedy Space Center in Florida. Because the piece of foam broke through the heat protection on the wing, during re-entry as the air became denser, they had no protection from the super-hot atmospheric

gases coming inside of orbiter's wing. Because of the fast speed the shuttle was traveling at, the air caused a friction with the wing which created great amounts of energy. The space shuttle exploded above Texas, leaving remains of the shuttle to fall on this land.

After this accident, President George W. Bush announced the retirement of NASA' Space Shuttle Fleet, which was more than 20 years old at the time, once they had completed the International Space Station. After spending about two years coming up with new ideas, and developing safety improvements, NASA's Space Shuttle Fleet resumed its launches in July 2005. In 2011 NASA launched its last Space Shuttle mission, which completed the Shuttle Fleet's role in the space station construction. I think that we should continue sending astronauts to space; because it's a whole new area we can and will explore. We need to learn from our mistakes, continue searching for new information, and our mistakes shouldn't keep us from moving forward.

Emilia Artusio
Grade 10

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Opportunity

Opportunity is a robotic rover that was launched on July 7, 2003. Opportunity has been actively roving Mars ever since. Opportunity has not had any mechanical problems that we are aware of, and has been exceeding the lifespan that N.A.S.A predicted it would have. Opportunity has found and roved a lot of amazing places and things, one of them being Victoria Crater, which it explored for over two years.

Opportunity is currently being watched over by the Jet Propulsion Laboratory, at the California Institute of Technology, in Pasadena, California. Opportunity is being watched carefully, and diligently.

Opportunity has six wheels, it's made all out of metal, it runs on solar energy, and stands 1.5 meters high. Weighing 180 kg., and being 5.2 ft. long, Opportunity is pretty big.

Opportunity landed in Eagle Crater, on January 24, 2004,. a very successful landing as the people in the control room would say.

Opportunity broke a record, on March 20, 2005, when it made the longest single day drive known to Mars, driving 722 ft. That was surely not the last record it would break.

Opportunity had a minor defect. When Opportunity's arm joint wasn't working, everyone was devastated. The N.A.S.A team first discovered Opportunity's problem on, January 25, 2004, Opportunity's second day on Mars. The arm was fixed, with a back-up plan that N.A.S.A, doesn't go deeply into.

Aidan O'Donnell
Grade 7

Kepler: Staring at One Spot in the Sky to Help Us Move Forward

Kepler was launched on March 7 2009 and was originally going to be in space for 4 years. Kepler is an observatory telescope that has a fixed field of view in a spot in the right wing of the constellation Cygnus, about 115 square degrees big that only takes up 0.28 percent of the earth's view of the sky. Kepler's mission is to find other planets in the universe. To find planets, Kepler examines stars for a period of time and if there's a waver in the star's brilliancy it calculates that the star is being orbited by a planet, much like the way Earth orbits our sun. It watches the star to see how long the planet will take to pass across the star's façade again and using Kepler's Third Law of Planetary motion, Kepler scientists are able to tell from that data how far away the planets are from their stars, how big the planets are, and if it's a rock-form planet or gas-form.

After that, they can determine if the planet is in the habitable zone depending on how far the planet is from its star. The habitable zone of a solar system is where Earth orbits and it's in the habitable zone that people believe a planet will be most likely to have life on it. This is the main mission and original reason that Kepler was put into space for. So far, Kepler has not found any life on other planets in the habitable zone since planets need a certain size, mass and form (rock instead of gas) in order to qualify as a potential second earth. Even if it hasn't found this planet, Kepler has found some very interesting planets and planetary systems.

There are currently 115 confirmed planets and 2,740 planet candidates. There are 2,165 eclipsing binary stars, which is a system of two stars orbiting each other. There is a steady flow of new candidates that come in with new info that Kepler sends back to the scientists for them to analyze. For example, 461 new planet candidates were confirmed in January 2013. A recent study has revealed that 17 percent of the stars Kepler analyzes have an earth-sized planet. That would be one in every six stars.

37-b, discovered in February 2013, is the smallest planet Kepler discovered, being one third the size of earth and is 210 light years away in the constellation Lyra. It was discovered in Kepler-37, the smallest planetary system Kepler has discovered. The first planet discovered in the habitable zone was Kepler 22-b, 2.4 times bigger than Earth, found December 2011. A strange planetary system was discovered in June 2012.

Two planets were found to be closely circling the same star and were orbiting close to each other. Kepler 36-b is the inner planet, 1.5 times bigger than the earth, weighing 4.5 times more and is a rock-form planet. It orbits its sun in 14 days at a distance of 11 million miles. Kepler-c is 3.7 times bigger than the earth, orbits at a distance of 12 million miles in the time of 16 days and is a gas-form planet. These planets get in close proximity every 97 days about less than 5 Earth-to-moon distances away.

The first planetary system Kepler identified was Kepler-9, found August 2010. Another interesting planetary system was Kepler-47, discovered August 2012, which is the first eclipsing binary star system that Kepler discovered. Located in Kepler-47 is planet 16-b, which happens to be in the habitable zone and has a double sunset due to its location. After the discovery of Kepler-47, Kepler scientists became open to the idea that planets can be part of multiple star systems.

It's believed by Kepler scientists that there is an earth-sized planet with two moons circling a red dwarf star only 13 light years away. But since it circles a red dwarf star, it's unlikely that there's any life on it. Kepler data recorded 95 planets orbiting 64 red dwarf stars. None of them are the right size or temperature to be considered a habitable planet nor are they the proper distance from their star for them to have the slightest possibility of any kind of life surviving.

Kepler was named after Johannes Kepler, a German mathematician who was well known for creating the eponymous laws of planetary motion. Kepler fitting name since the telescope searches for planets and planetary systems. The Kepler program isn't strictly NASA controlled either. It is open for citizens to use and through this opening, a Yale-led program has been enlisting citizen scientists and after thoroughly searching through Kepler's data they have found a planet that orbits a double star and is in turn, orbited by two distant stars. This is another rare example of a strange eclipsing binary star system.

Kepler will be in space for the next 4 years looking for planetary systems and planets in the habitable zone. It went into a rest mode from January 17 2013 to January 24 2013 to prepare itself for the continuation of its mission. Kepler will be in space for around 7 ½ years and is expected to be finished around 2016. Kepler's data is catalogued, analyzed and distributed by the Space Telescope Science Institute in Baltimore Archives.

Kepler is 2,320 lbs, 3.1 ft in diameter and follows the earth in a heliocentric orbit. It falls ever so slowly behind the time that the earth takes to circle the sun, which is 365 days. Kepler has an orbiting time of 372.5 days. The Kepler's height is 92,955,807 miles. The entire Kepler project cost NASA 600 million dollars and will cover the entire Kepler mission until 2016, which is Kepler's estimated end mission date.

Kepler will continue searching for planets and planetary systems in the hopes that it will one day find a planet in the habitable zone with life on it. But for now, Kepler will continue introducing us to new and interesting planets with things to teach us about how our universe works, all by staring at one spot in the sky.

Anya Ledner
Grade 11

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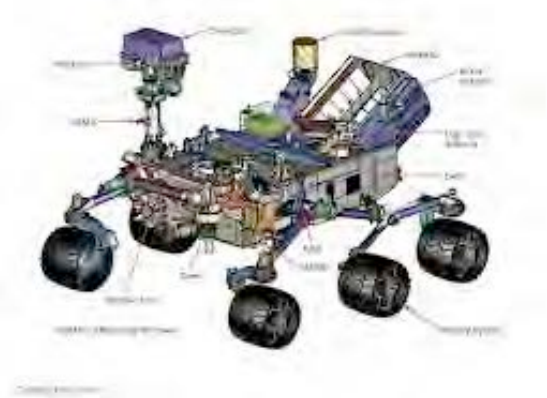
Curiosity

Is there life on Mars? This has been a question asked for decades; now newer and better technology is helping us search for the answer. The latest Mars Rover created by NASA, Curiosity, is currently searching Mars for proof that the planet might have been able to sustain life in the past or in the future. Curiosity was launched on November 26, 2011, and is predicted to explore Mars for one Mars year or 23 Earth months. In order for Curiosity to collect samples and have the magnificent abilities that it does, it has to have many tools, which make it very large. Curiosity is 9 feet, 1 inch wide; 9 feet, 10 inches long; and 7 feet high; just about the size of an SUV. The Rover weighs 2,000 pounds (900 kilograms) and has a 7-foot "arm" to help it collect samples and other information. The Rover has what is called a warm electronics box or "WEB" that is a protective outer layer that keeps Curiosity's computer and electronics safe and temperature controlled. Curiosity's wheels are 20 inches in diameter and are designed to roll over obstacles up to 25 inches high and cover about 660 feet of land per day. Curiosity has 6 wheels and each has its own motor; the two front and two back wheels have their own individual, steering motors that allows the Rover to turn a full 360 degrees. The Rover's wheels and "legs" are designed to go all the way to a 45-degree angle and not allow it to fall over because that

would be the end of its exploring. On a flat, hard surface the Rover can reach up to 4 centimeters per second.

The arm is based on a human arm. It has 3 joints that it can move with: a shoulder, elbow, and wrist. The arm has the ability to bend and angle against rocks in order to collect samples and microscopic images. At the end of Curiosity's arm there is a turret that holds multiple tools and can turn in a 360 degree spinning range. The arm of Curiosity might be considered by some as the most impressive structure on a Mars Rover yet.

Though the body or structure of the Rover is very important, the computers are really what collect all the information and direct the Rover. The Rover has 2 "computer brains", one of which is normally asleep. The backup computer is there if there are complications with the main computer and the Rover somehow cannot function. A flight team located on Earth controls the Rover's computers. The Rover also has 17 cameras, 6 of which are used for navigation and 4 for scientific observations.



One of the hardest parts of building this Rover was designing a way to land it on Mars. Once the rover hits Mars's atmosphere, it heats up to 1600 degrees. A parachute is deployed but that only slows it down to 200 miles per hour. Next, once the Rover is about 60 feet from Mars's surface, it detaches itself from the parachute and protective capsule. Rockets are activated and the Rover descends from the hovering craft by wires. This all happens within 7 minutes. Curiosity landed on Mars on August 5, 2012.

It has always been a big debate whether or not research on Mars is worth the cost, but I think it is. Yes, there are still issues here on Earth that we need to deal with, but exploring other planets is a great opportunity we have. There will always be things we don't know about space and I think that's what gives us hope and excitement about the future.

Dela Hatfield
Grade 8

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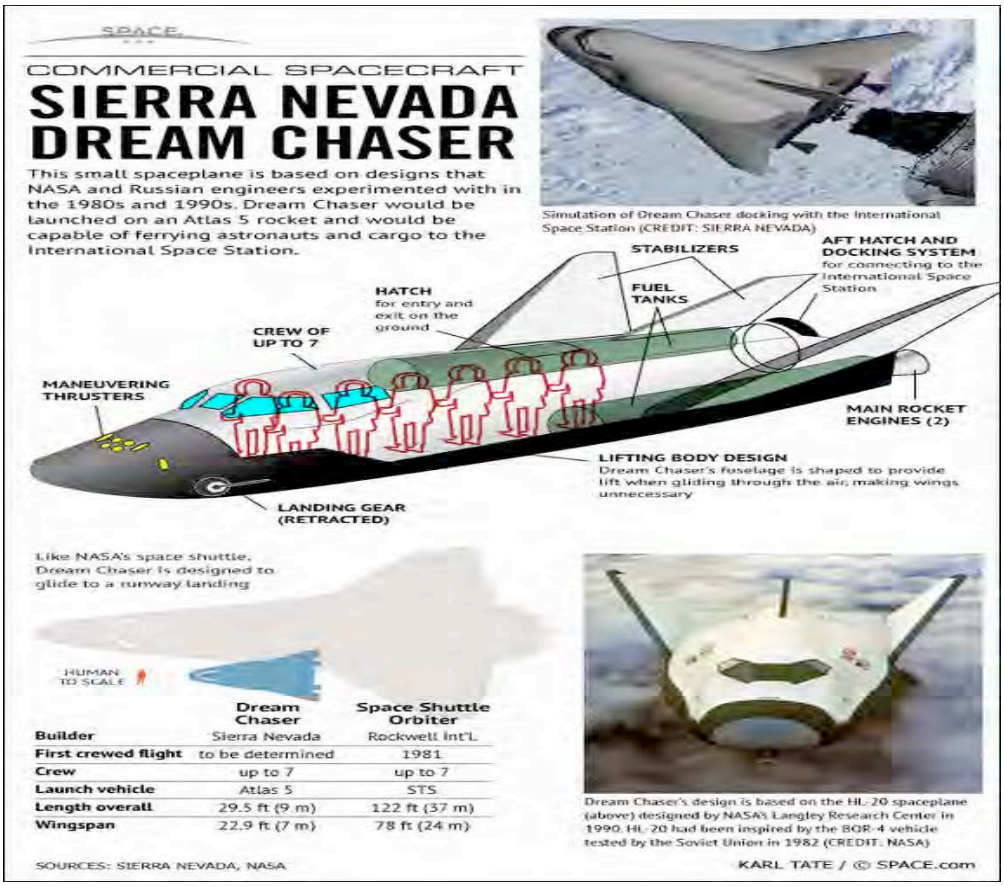
Dream Chaser, the Future Space Shuttle

There are many designs and ideas about the new shuttle, since the old one was retired, but the most promising right now is NASA's new dream chaser. In this essay I hope to explain not just how the dream chaser works, but its purpose as well

The dream chaser will take off from the top of an Atlas V rocket. Once in orbit, its engines will coast it to the appropriate height. Once it gets close enough, it will dock with the ISS, (international space station), and will remain there for a few weeks. Once it's time to go home, the dream chaser will reenter through the atmosphere, once again using the heat plates on its under belly. Here's a cool fact. The dream chaser's fuselage creates lift, so wings aren't necessary. And just like the old shuttle it has landing gear, so it can land on a runway. But instead of landing on the Air Force's 5-mile long runway, it can land on conventional runways, again, cutting the costs of space flight. But the real history of the dream chaser, especially the no wings part, came from Russia, and from the breakthroughs in airplane noses. This makes it possible to travel at supersonic speeds, with less air resistance. So when the plane was reemerging into the atmosphere, it was safer. But the shuttle needs a way to get up to earth's orbit. Instead of using two solid booster rockets and a giant fuel tank, the dream chaser ony uses one Atlas V liquid fuel rocket, cutting the costs of launch in half. To manuver in space, it has manuvering thrusters on its body.



The design for dream chaser is very cost effective. It can land on smaller runways, and this cuts the costs of a launch in half, making it very cost effective. Space X already has a pod that can carry supplies, but not people. This is why the dream chaser will prevail. I think that someday, this will be our reality. This was Byron Osborne, reporting on the future space shuttle, dream chaser.

Byron Osborne
Grade 7

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United States and Russian Relations in Space

The shuttle program was started by NASA in 1981 as a way to transport payloads into low orbit, things like supplies for the International Space Station. After many years of providing efficient and routine missions to the ISS, the shuttle program was retired in 2011 due to the depressed economy along with other programs. After the shuttle program was cancelled, American astronauts still needed to get into space. The next country in space travel and exploration is Russia. Since the end of the shuttle program in July of 2011, the United States and Russia have had to collaborate and join forces to continue to get Americans into space.

Unlike the spacious shuttle the United States had used, the Russians use a fleet of rockets known as Soyuz. The Soyuz rockets are Russia's most reliable and economical spacecraft to date. A Soyuz rocket can carry 3 crew members and life support for a crew for up to 30 days. The Soyuz fleet offers limited cargo space, making it impossible to transport large pieces of equipment for repairs or just general maintenance of the ISS; this is where the shuttle was extremely useful. In an interview between the Russian Deputy Prime Minister Sergei Ivanov and Charles Bolden, head of NASA, Sergei Ivanov said that the Kremlin, home of the Russian Federation and the nation's president want to travel further into the Solar System with the United States. However, to do so both sides would need an increase in financial support which is a very big issue considering the world economy.

2011 was a year of disappointments for NASA and was the beginning of a path that would lead to more reliance on the Russian space program. President Obama cut from the budget funding for the U.S. Constellation Human-Flight Program which prevented NASA from returning to the moon for an extended length of time. The United States will also be looking at private companies, instead of NASA for the next space craft to replace the shuttle. NASA also signed a 200 million euro contract with Russia to take astronauts to the ISS starting last year in 2012. Russian Academic Yury Zaitsev said in an interview that he expects the U.S. will be relying on Russia to get astronauts to space until 2020 considering how long it will take for a new space craft to be designed. The changes that the U.S. has made in the past several years have made us more dependent on other countries to get into space, not just on the Russians.

In 2010 Obama said in an interview that his goal for human space exploration is to go beyond the moon and deeper into the solar system by the year 2025 despite the end of the shuttle program. As a way of showing how strongly he believes in this goal he said that during his life time "American will send astronauts to mars and bring them back safely." However skeptics such as Neil Armstrong say that, so far, what Obama has done for space exploration has been "devastating." On the other side of the world, the Russians are expecting to spend around 70 billion dollars within the next several years on their space program and expand their outreach into the solar system just as the United States wants to do. Russia's goal is to get a man to Mars by 2035; the U.S. is included in this goal.

Both countries have goals and expectations for space exploration beyond the ISS and further into the Solar System. The United States is heavily relying on Russia to continue going into space at this time, and it is crucial that a new ship be built to replace the shuttle. This isn't a one-way relationship however, each country is benefitting from this joint effort. The ambitious goals of Russia's space program and the technically advanced NASA teams create a dominant and top grade force that will venture further than man has gone before.

Ryan Reish
Grade 11

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The Clash of the Two Intergalactic Bodies

On July 1994, numerous comets collided with our beloved planet Jupiter. The comets known as "Shoemaker-Levy 9" was originally one stray comet that divided into multiple parts, nearly all clashing with Jupiter. According to astronomers' calculations, the comet was divided into parts unusually due to the previous approach towards Jupiter in 1992. The orbit of Shoemaker-Levy 9 trespassed Jupiter's Roche limit and tidal forces pulled the comet into multiple pieces. The impact of the several fragments of the comet was the cause of the famous "Great Red Spot" as well as multiple damage wounds on multiple parts of Jupiter's southern hemisphere. According to mankind's knowledge this collision of two intergalactic bodies has never happened before which was very exciting for the astronomical community. It may be considered a proud event on our astronomical time line.

The discovery of the Levy-9 occurred in March 24, 1993, by a photograph taken with the Schmidt telescope at the Palomar Observatory in California. The comet activity and outcome was discovered and observed by astronomers, Carolyn and Eugene M. Shoemaker and David Levy. It was initially the first comet ever to be found orbiting a planet, and apparently Jupiter abducted its route to the center of our Solar System around 20 to 30 years earlier. All comet orbit cases that have been found at the time were located around the circumference of the sun, which has the massive gravitational pull to make the occasions common. Because of that this is a massive break through in our limited astronomic education.

The impact of the comets against Jupiter's southern and northern hemispheres left brown scars on its surface. Most of the damage that was inflicted took place on Jupiter's southern hemisphere. Astronomers hoped the asteroids' effect on the planet would reveal

Jupiter beneath the gas cloud tops. As predicted beforehand, the collision of the two significant bodies caused enormous intergalactic waves. There were also many types of chemical changes, such as aura emissions, discovered within Jupiter's territory using radio waves.

It is appropriate to be thankful that the comets collided with Jupiter. The damage Jupiter's surface sustained would have easily smashed our planet into pieces. The indications of the incident that happened in 1994 on Jupiter are that we should be more appreciative of our location in our Solar System. Our position is the ideal distance from the sun allowing us to live. Also we have planets that, in a way, are protecting us from drifting debris heading our way. As well as an atmosphere shielding us from falling rocks, and an unlimited supply of oxygen for us to go about our lives, undisturbed.

Andre' Dongieux
Grade 9

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On the Path to New Discoveries

Summary

Space exploration has been a part of the human race since the beginning of time. It was not until the late 1950's that the human race began to leave planet Earth in order to explore space. We have come a long way in our technological advances since the 1950's. The closing of the United States Space Shuttle program in 2011 has left many people to look for other opportunities for continuing space exploration. However, the end of one great government programs gave rise to a private program, Space X. In order for us to move forward in space, we must take time to look back into the past and review our successes and failures.

21st century space travel has been made possible in the United States by their Space Shuttle program. For more than 30 years the Space Shuttle program had pushed the limits of engineering and their fast working workforce. They created "humanity's first reusable spacecraft …it pushed the bounds of discovery even farther." (Ryba, NASA)

However, even great engineers can make mistakes. In 2003, the Columbia Space Shuttle was lost, along with seven of the crew on board because NASA had failed to acknowledge the extent of the insulating foam's damage to the Columbia Space Shuttle.

Following the Columbia disaster, the space shuttle program was stalled for two years. Since the closing of the Space Shuttle program, the United States has been using the Russian Soyuz Space Capsules in order to maintain the International Space Station (ISS). The International Space Station has been in orbit since 1998 and is collaborating with several countries, and is very important for providing a place for experiments in space to take place. The ISS is projected to keep orbiting until 2016. The United States has announced the emergence of a new Shuttle named "The Dream Chaser." (Fox News) With the upcoming shuttle we plan to continue space exploration with the ability to cut the cost of a Space Shuttle launch by millions of dollars per launch.

In 2004, Opportunity reached the surface of Mars. Opportunity has been able to give us insight to the terrain, climate, and much more of Mars. In 2012, Curiosity landed on the Martian surface. Curiosity is the newest of the Mars rovers. The purpose of the Mars rovers is to examine Mars, and search for elements that could possible sustain future life. Along with the Mars rovers, the Kepler Observatory Telescope was launched in 2009. Kepler stares into one single spot in space in search of new planets. Currently, Kepler has discovered 114 confirmed planets and 2,740 planet candidates. The ultimate goal for Kepler is for it to discover a planet within the habitable zone that can hopefully support human life.

Planet Earth is located within the Solar System, and its location is key because it managed to avoid comets back in the late 1990's. We must take Earth's locations to our advantage and continue space exploration, which has been around since the beginning of time, however we have only begun to understand what space exploration truly means. In order to broaden our knowledge of space we must come together and form collaborations such as the International Space Station. Space is so enormous that without the help of other countries, we will never get far because in order to keep advancing we must invest time and money into numerous programs that will enable us to keep learning about space. Not only that, but we must also take into account that we have failed in the past, and we must learn from our mistakes, and apply our knowledge for future explorations.

Zinnia Gonzalez
Grade 12
Group Leader

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Chapter 5
NASA Spin-Offs

Is It Worth It?

Throughout the mid 1900's, NASA began to sponsor a group of researchers who were developing a fire resistant material for the space program as well as the air force and later on, the fire department in the United States. This fabric was called PBI.

Believe it or not, NASA served a big part in developing suitable fire resistant material for firefighters and for members of the U.S. Air Force as well. Insulating and protecting astronauts from temperature extremes from 455 degrees Fahrenheit, to as high as 1,533 degrees is obviously the most important thing in the NASA space program. After all, safety is always first, especially in space. Building on this, NASA has invested a huge effort in manufacturing fire resistant materials for vehicles, flight suits and other applications demanding extreme temperature tolerances. In the late 1950's, Carl Marvel first synthesized Polybenzimidazole.

He was currently studying the creation of high temperature tolerant stable polymers for the U.S. Air Force. In 1961, PBI was further developed by Marvel along with his partner Dr. Herward Vogel. They anticipated that, at the rate they were going, the polymers, once fully developed would have well above standard oxidative and thermal stability. NASA and the Air Force Materials then sponsored Marvel and Vogel's work for continuing considerable work with PBI for military and defense applications as a non-flammable and thermally stable textile fiber. On January 27th, 1967, a flash fire occurred on command module 12 during a launch pad test of the Apollo space vehicle as it was in

preparation for its first piloted flight. Three astronauts died as a result of this tragedy. The severity and immediacy of fire danger was made immediately apparent by this occurrence. A final report of the tragic event in April 1967 made specific recommendations for certain design and engineering modifications and adjustments including the control of combustible materials in the command module as well as in astronaut's flight suits. After this report was finished, NASA intensified its focus on non-flammable materials, and the agency began to consider PBI, given its knowledge of the fabric and its familiarity with the inventor.

NASA then contracted with Celanese Corporation of New York, with a mission to develop a line of PBI fabrics for use in astronaut suits and vehicles, and Celanese engineers developed a heat and flame resistant PBI fabric based on the fiber for high temperature applications. The fibers created from the PBI polymer showcased a variety of desirable characteristics including inflammability, no melting point and the retention of strength and flexibility when exposed to flame. Throughout the 1970's, it became instrumental to space flight as applications were seen on Apollo, Skylab and various shuttle missions. In 1978 PBI was introduced to fire service in the U.S. and project FIRES (Fire Integrated Response Equipment system) showed off a recently developed outer shell for turnout gear which was called PBI Gold.

So is it really worth it to continue government funding of NASA? I would say absolutely. With the development of PBI we have ensured the safety of astronauts, the Air Force, fire fighters and even integrating it into vehicles. I think it is totally worth it to invest a reasonable amount of money into NASA and partnering entities in order to broaden space exploration to whole new levels and keep everybody safe at the same time, since safety comes before anything else especially in the space exploration field.

Rufus O'Dea
Grade 10

Source

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Moon Base Alpha

Moon Base Alpha is an open RPG game in which six players have to fix the oxygen system of a moon base that got hit by an asteroid. The game provides a realistic

simulation of real world problems people have to face on the moon. The game is set in 2032 when NASA sends six observers and a rocket to a moon base that was built three years before. They spend 1 year there when an asteroid hits their base camp, crippling their oxygen system. To fix it, they have to use many sorts of tools and robots to fix the gas leaks created from the transformation system. The energy is absorbed by two solar panels, then that energy goes through power cables into the oxygen transformer, making oxygen for their sleeping quarters.

The game represents a normal day in the life of an astronaut. Some of the jobs they do are inspect and fix things and experiment with research gained. You are timed for your repairs, so you have to act quickly to repair the damages. NASA hopes to reach out to school children with this game because they want them to get more interested in space and the NASA program, which could lead to future job creations.

Moon Base Alpha started out as a tech demo for the game originally named Astronaut: Moon, Mars and Beyond! But Army Game Studio heard about the game and decided to join in the project. They created more ideas for the game, missions and more, creating the now famous Moon Base Alpha. The game is meant to be a collaborative effort, forcing the players to use teamwork to fix all the damage in time until time runs out. But an internet Meme sprouted from that. Moon Base Alpha included a text-to-speech voice that you can turn on. Let's just say you get the picture. But some players take it seriously. There are leader boards, so that you can beat somebody's score. The current record is five minutes and 10 seconds! By the time you read this, there will be more than 600,000 people playing the game. This game did average on the grading side; the game only got a 6/10 on major game sites. This is mainly due to there not being a lot of missions to do. But in my opinion this game is great. This game is important to NASA research because it could lead to more people becoming scientists for NASA. This game has made a big boom in NASA research because people that play the game have gotten better at problem solving, science, and stuff like that. But mainly, it is important to NASA research because it teaches kids what might happen in the future, like Moon bases on moons, colonies on Mars, and even beyond that. The people who play the game are making that future. Moon Base Alpha started out as a little game with a lot of inspiration. That inspiration was to teach kids what might become of the future. Who knows? maybe it will happen someday.

Charley Knowles
Grade 8

Solar Energy: Is It Worth It?

NASAs 2013 budget of 17.6 billion dollars was approved in early 2012, keeping the overall budget of NASA flat over the last few years, but the question remains: is it worth it? In particular NASA's development of solar energy, is it worth your tax money? Many of the developments made though NASA are also useable on earth, solar energy being one of those.

Many people around the world benefit from the innovation of solar panels to power their households. Solar energy and panels were clearly used and innovated by NASA, but it is important to know they didn't invent them. Ever since the invention of solar panels in October of 1955, 57 years ago, NASA has been interested in the development of them. Bell Labs, the inventor the solar battery, went on to supply solar energy power for NASA's first permanent satellite in 1958.

In space there are not many options as to a power source; no power outlets are available, no gas stations, but thankfully our sun provides us with the option to collect solar power. In space solar power provides most, if not all, the power used during missions. It supports life and keeps important spacecraft functions operating. Solar power is so important to NASA, and their quest to explore rural space, that they invest considerable money and time to create efficient, affordable, and lightweight solar panels.

Just about every space mission NASA has launched has required solar panels, such as the ISS, the International Space Station. It has eight 114 foot long solar array wings. Each of the eight wings on the ISS contains around 33,000 solar cells, which convert 14 percent of the sunlight that hits them into useable energy. This provides plenty of power to the ISS and much left over. But the ISS features older solar technology. Newer developments of NASA and their partner companies resulted in the development of an extremely portable, flexible, and efficient panels, converting 90 percent of the sunlight that strikes them into useable energy. The developments of solar energy for NASA are done in the Photovoltaic and Space Environments Branch, an entire division dedicated to the development of solar energy and related issues.

NASA's developments of solar energy have greatly benefitted us here on earth, but may more so in the future. A newly funded project called SPS-ALPHA, which stands for Solar Power Satellite via Arbitrarily Large Phased Array, can potentially beam solar energy to earth from the satellite in space. The earth pointing side of this array is covered in tiles designed to collect microwave-power, a low intensity beam of radio frequency energy and then transmits that back to earth. If this project is successful it could affordably provide 10's to 1000's of megawatts of energy useable on earth. Now that is a reason it is worth it to invest in NASA and its developments of solar energy, to provide a better and more affordable source of energy for the future.

Timmy Johnston
Grade 10

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How NASA Inspired the Roller Coaster

Since July 29th, 1958 The National Aeronautics and Space Administration has hosted a long tradition of new breakthroughs in technology and physics. These breakthroughs have influenced and created many so-called ‘NASA Knockoffs’ that even the average person, that isn’t an astronaut, could be seen using. Another tradition that has long hosted physics, and that has been strongly influenced by NASA is the average run of the mill roller coaster that you will see at many theme parks today.

In 2002, a film called “Space Cowboys” was released, and it was this film that inspired me to choose the topic of roller coasters. The film is basically about a group of former astronauts, 40 years off the job, that have to go back to space in order salvage some sort of important satellite. Anyway, it was the character Jerry, a former engineer. His days at NASA had long since passed. With his set of skills and knowledge of physics led him to become a roller coaster designer. It was this film that really sparked my eye, but I don’t really recommend it to anyone.

Lamarcus Adna Thompson, aka ‘The Father of Gravity,’ invented the very first roller coaster in 1885. As you could imagine these contraptions were made of wood, and were actually inspired by railroads on mountains that would pick up serious velocity. The wood-based coasters evolved to steel based, and as coasters continued to evolve NASA would eventually peep its head in to take roller coasters to another level. The latest advancement to inspire a breakthrough in roller coaster culture is NASA’s Zero-Gravity KC-135, dubbed by the media, ‘The Vomit Comet.’

This contraption will be worth around twice as much as a normal roller coaster, but those that want to experience serious weightlessness for 10 seconds will not have to assemble huge sums of money to venture into space. The ride is currently still being adjusted to more of a theme-park feel, but they are finding most difficulty finding ways to make it operate hundreds of times a day. As for the first person to ride the new and

improved ‘Vomit Comet’ Harold E. Talbot, the first operator of the KC-135, might just be the man for the job.

Whether or not these roller coasters are worth it is a tricky question. Some, I’m sure are skeptical about the idea of spending hundreds of millions of dollars on things that really aren’t essential to human existence. But for those thrill-seekers, I bet they have absolutely no problem with the spending, and find it 100% worth it. Either way, roller coasters have been a staple in American Culture, and I have a feeling they will be for long to come, so long as NASA can continue to give designers the latest on breakthroughs in physics.

Clayton Parker
Grade 10

Medical Space Spin-offs

In outer space there have been inventions that were originally made to change space travel. But now we find that they change the world on the ground too. One of NASA’s biggest accomplishments in changing the world in space and on the ground is in the field of medical technology. NASA has made many discoveries that were originally made for space and now benefit the lives of those who are critically ill. Some of these technologies include microscopic bubbles that help kill tumors, fiber optic scopes for surgeries, LED lights that relieve pain, and ear thermometers. All of these were either invented by NASA scientists who used their knowledge of outer space to make devices that benefit the earth, or they were invented using NASA technology from the space program. This paper will be focusing on two big medical advances led by NASA. The first is that of a Ventricular Assist Device (VAD) to keep the hearts pumping for patients in need of a transplant. The second is how NASA has benefited prosthetic limb technology, and other conditions using memory foam. Using this information we will conclude by deciding whether or not this technology makes NASA worth all of the tax dollars we spend on it that could be going towards something else.

The VAD just mentioned is a very big deal when it comes to NASA space spin-offs. This device is very small; in fact it is one tenth the size of most other VAD’s. It is one by three inches large. The smallness of this device is ideal, because that means that when inserted in and out of the body there is less risk of infection because the size of the cut is smaller. This device is used on patients who are in need of a heart transplant, but do not have a donor yet. It will keep the heart pumping as long as needed for a donor to come through. In fact this device works so well that people are trying to get it to be a permanent

replacement for the heart so that the patient does not need to worry about getting a donor. Now you are probably wondering, how does NASA space technology apply to a VAD? Well this is how. It all began when a NASA engineer named Dave Saucier from Johnson Space Center, worked with the doctors, DeBakey, and Noon, heart surgeons from Baylor College of Medicine. They had some conversations about a VAD device and started to invent one. Their device worked fine, except there was too much friction in the device where the blood traveled too fast, and that friction damaged blood cells. Also there were areas of the device where the blood ran too slowly and would clot. Because of these reasons the device was not safe to use on patients because it would risk blood clotting and damaged blood cells. What they needed was for the device to have a smoother flow of blood. This way the blood wouldn't go too fast and damage the blood cells, and the blood wouldn't go too slowly and create blood clots. So they called in for some help from NASA engineers at Ames Research Center. They were called in because these engineers had experience working with the turbo pumps in the engines of NASA shuttles and rockets. The scientists who started the project assumed that the engineers from Ames Research Center could help because they understood how to make fuel flow smoothly through the rocket engines. Using information from the NASA supercomputer, the engineers worked together to create a heart pump that had a smooth blood flow. A lot of the technology that was helpful from the NASA supercomputer was information about the space shuttle and the engines inside of it. So NASA engineers, and heart surgeons, using information from the NASA space program, invented a very small VAD. The device was used on its first patient in 1998 and as of 2011, the device has been used on 160 patients.

A device that still benefits us today from NASA is Temper Foam. A NASA engineer named Charles Yost in 1966 invented Temper Foam. Originally it was invented in a project to make NASA's airplane seats safer and more comfortable. After a while Yost created his own company, Dynamic Systems Inc in 1967 so that he could sell and make money off of his invention. Temper Foam is the same thing as memory foam. When one leans on the foam it will mold to you and then go back to its original shape after one leaves the foam. The foam has been used in a lot of different things since it was invented, for example the helmets of the Dallas Cowboys during the 70's and 80's, shoes, beds, cars, and theme parks. But lately people have found that Temper Foam can also benefit those without limbs as a prosthetic limb. The foam is molded so that it mimics muscle structure and skin tone. Some benefits of Temper Foam prosthetic limbs are that they prevent friction and irritation between the skin and the prosthetic limb because of the texture of the foam. The company that is doing this is Otto Bock Healthcare PLC. Otto Bock uses a variation of Temper Foam that can be custom molded into the ideal shape. This variation of Temper Foam is called SunMate. These prosthetic limbs actually feel and look like a real arm. Temper Foam has an open cell structure, and because of this open cell structure to temper foam there is less heat buildup from the limb on the patient so that the limb is more comfortable. Temper foam has also been used in other ways for medical advances. It has been used for those with specific muscle needs and wheelchair seating so that the person in the wheelchair is more comfortable since they have to sit in the wheelchair for such a long time. Yost's company, Dynamic Systems Inc, did this. The seats are made using FIPS technology, Foam In Place Seating. FIPS was invented so that

it could be molded to the patient's body. FIPS technology involves taking liquid SunMate, and putting it into a custom mold for the patient.

We have looked over the benefits of VAD's and Temper Foam. Both of them were invented by NASA engineers. Sometimes people say that our tax dollars are not worth being spent on space and that we should be spending our tax dollars on something else. This is partially true, but one thing that we have learned from this essay is that NASA technologies not only benefit the world above us, but also the world around us. If we can explore space and benefit the world around us then NASA must be fine. The VAD made by NASA engineers couldn't have been made if it weren't for the technology that the engineers found in the space shuttle engines. Sometimes to solve a problem like that, one needs to look outside the box. And the result of the NASA engineers looking outside the box and checking the space shuttle engines to make a VAD was great. The NASA VAD has specific advantages to other VAD's because of its small size. The same goes for Temper Foam. One can take a great idea originally used for NASA and then turn it around and use it to help those without limbs or those in wheelchairs. So space exploration is definitely worth it because we can win both on the ground and in the sky.

Sam Robertson
Grade 10

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A Spinoff by NASA

NASA has had some incredible partnerships, creating unthinkable products that we take for granted each and every day, for example the water filter. Another technically advanced surprise spinoff from NASA is actually, believe it or not, a swim suit. A speed suit, technically designed to have absolutely no drag, and to enhance the performance of whoever wears it.

Both a space shuttle and a competitive swimmer have more in common than you might think. They both have to compete with vicious drag, whether it's a space shuttle or a swim suit, through air or through water, they are the same. NASA's aeronautics mission mainly focuses on improving flight efficiency, fluid dynamics, and forces of pressure and drag. Drag is the force of friction slowing down a moving object. After the 2004 Olympics Speedo asked for a partnership with NASA to create a speed suit with as minimal drag as possible. NASA would use wind tunnels for fluid dynamics research and study the forces of friction with different fabrics. And after over one hundred tests they came up with the LZR Racer by Speedo that was over the shoulders and went down to your ankles. It was made up of a fabric Speedo calls a LZR pulse, which is lightweight, repels water and has very reduced drag. NASA's wind tunnel results also allowed Speedo to create bonding of fabrics that would completely eliminate seams (seams also cause a lot of drag).

This suit was launched February 13th, 2008, as the fastest swimsuit on the market. 94 percent of all races won, and 98 percent of all medals earned were by people wearing this suit. By August 24th, 2009, 93 world records had been broken with this suit, but in January of 2010 a FINA rule stated that the LZR Racer swimsuit was giving an unfair advantage. It was considered technical doping, therefore the FINA rule banned any swimsuits to go over the shoulders, up the neck, past the knees. It must be thin enough to not affect your buoyancy, and you cannot wear more than one suit when racing. (Air bubbles would get trapped in the suit creating buoyancy.) Luckily the only rule that went against this suit was that it went to the ankle in length, therefore it is still legal and used today in a different form.

Speaking of swimming, this next spinoff of NASA's is used in swimming pools today, along with the water we drink; it's the water purifier. 17 percent of global population lacked a safe water source in 2002; that's about 1.1 billion people. NASA began developing space craft water purification systems for the Gemini program in the 1960s to create a way to re use waist water for drinking water. Although its first success came from the Apollo-Era of technology, for the lunar missions, they developed a light weight purifier that was designed for minimal power consumption and monitoring. Soon after, a private company allowed NASA to modify the purifier for commercial and industrial use. The purifier works by passing a small electrical current through copper and silver electrodes, releasing ions into the water purifying the water. The ions kill bacteria and algae in the water by breaking down their enzymes, and the ions and dead organisms are filtered out of the water. These water filters have helped worldwide with the quickly increasing need for water. For example, in 1994 a prime minister of Vietnam endorsed an

order for 10,000 of these iodine based purification units, providing clean water to between 50 to 70 million people.

I believe that both the LZR Racer speed suit and the water purifier were worth the time, money, and research. Although it sounds pointless to put so much research into a swim suit that will just become illegal anyway, the fabric and the design were ingenious and is still used today. (It just goes down to your knees not ankles.) In fact, most speed suits today are based on this suit and using similar styles and the same glue bonding. The water purifier was one of the most important and useful creations of NASA's. We need clean water, and the fact that these purifiers are easy to use and transport, makes it that much easier to help those who don't have clean water. So thank you, NASA!

Ali Powell
Grade 10

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HIGHWAY SAFETY: HOW NASA IS HELPING THE EVERYDAY HUMAN

"No place has played a larger role in the history of American flight technology or flight technology in general than Langley Research Center," said Tom Crouch, aviation historian at the Smithsonian Institute. The Research Center's Safety Grooving Research Program is responsible for taking the knowledge it gained from in-depth studies about aircraft tire hydroplaning and applying it to highway safety. We now have safer interstate highway curves and overpasses, parking lots, pedestrian walkways, ramps and steps, and animal holding pens, all because of NASA.

NASA Langley Research Center was developed in 1917 in Virginia, the first civilian laboratory focused on unlocking the mysteries of flight. In the 1960's they began studying hydroplaning problems for aircraft and land vehicles. In 1966, to determine if grooving highways would be helpful, a section of highway in California was selected for testing because of its high occurrence of wet pavement accidents. The two years of tests resulted in a 98 percent decline in accidents. From January 1981 through January 1988, nearly 400 commercial airline traction-related accidents occurred. Aircraft ran off ends of

runways or ran off shoulders. The many crew and passenger deaths motivated intense research programs between government agencies and industry. "Our goal is to define runway surface maintenance requirements and minimum friction level limits in adverse conditions," said Tom Yager, senior engineer, Landing and Impact Dynamics Branch at NASA Langley. Scientists proved that grooved runway surfaces had much greater friction properties than non-grooved surfaces, especially at high speeds. During the mid 1980's, tests were conducted on twelve different asphalt and concrete runways, including snow, slush, dry, wet and ice-covered surface conditions. There were over 200 test runs made with two transport aircraft, and over 1,100 runs made with a variety of ground vehicles. The studies found that speeding was reduced, stopping distance decreased, and a vehicle's cornering ability on curves was increased on the grooved surfaces. Jarmaine Safety Grooving, the horizontal grooves in concrete that increase traction for all types of aircraft and automobile tires, was developed and is now being used all over the world. "This technology was inducted into the U.S. Space Foundation's Technology Hall of Fame in 1990, referred to in space circles as "The Academy Awards of Space Technology Spinoffs"-- the Hall of Fame honors individuals and companies responsible for the practical application of aerospace research."

With the development and application of Safety Grooving, accidents on slippery highways are down as much as 80 percent, and injuries caused by wet surfaces on playgrounds, swimming pools, work places and factories have all been reduced. Thanks to the research done by NASA at its Langley Research Center, we can drive more safely on our roads and fly more safely in airplanes!!

The main question that most people have is why should money be invested in NASA? Money is being invested in NASA to teach us things about space, giving our population smarter cars that can park themselves, giving our firefighters safe gear, inventing comfortable beds for us to sleep on (Temurpedic mattresses), water filters, very fast bathing suits, artificial limbs, invisible braces, aircraft anti-icing systems, **highway safety,** solar energy, improved mine safety, and chemical detection. Imagine if we didn't have any of this -- that's why we should invest our money into NASA.

Claire Baker
Grade 7

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GPS Technology

The National Aeronautics and Space Administration has created many of today's simplest inventions to the most complex inventions. But, in fact, NASA may have been given absolute credit on one too many inventions. For instance, in the case of global positioning system or GPS, NASA may have played as developer rather then the inventor.

Prior to its existence, the GPS was no more than a subtle dream to people like treasure hunters, pilots or just the common traveler. Before the GPS, these people would have to rely on a compass or a map to make their way around, so for them it was definitely worth it for NASA to develop the GPS. Like I previously stated, the GPS was not a solo effort as Ivan Getting and his 12-billion taxpayer dollars brought up the actual idea. It was with a lot of this money that NASA came to contribute its knowledge in space and its satellite technology to make Getting's dream come to reality.

GPS transmits signals to equipment on the ground. The GPS receivers require an unobstructed view of the sky so they are only used outdoors and often do not perform well within forest areas and near tall buildings. The GPS operation depends on a very accurate time reference and that is provided by atomic clocks. All of the GPS satellites have atomic clocks on board.

Jack Parker
Grade 8

NASA Spin-offs
Summary

For over 50 years, NASA has been funding technological programs meant for space travel, or just for the sake of mankind However, many great ideas such as the Ventricular Assist Device and artificial limbs have grown from the research as well as many more that people use on an everyday basis and wouldn't have expected that they came from NASA's development program. I personally believe that the human race has benefited from the research greatly. Where do we go from here? We don't know; we have ideas about what the future holds for us and what we would like to see, but I believe NASA could carve a highly sophisticated future for the human race, with endless possibilities.

NASA used their technological advancements for the space program, to help people that were in really bad health situations, such as heart disease missing limbs, tumors or other health issues. One big advancement that NASA had was the Ventricular Assist Device (VAD) which was built and designed in collaboration with NASA engineers and heart surgeons from the states. With a super small design and the ability to let blood flow super smoothly, the VAD was created and put into production. It was

meant for patients who didn't have a heart donor yet. The VAD ran up to 8 hours with batteries.

Another great example would be the fire resistant suits, firefighters and fighter pilots of the U.S. Air Force use these suits on a daily basis, perhaps shooting down enemy pilots or saving a people from a burning house. It started off with the design of fire proof polymers used for the space shuttle. When NASA completed the fire resistant polymer known as PBI, the U.S. Air Force began to fund this new product. It could withstand temperatures from 455-1533 degrees Fahrenheit, keeping our men safe up top and on the ground from fire. Was it worth to fund NASA's program for PBI? Yes, because its used in many everyday objects, such as vehicles, fire suits, space suits, flight suits.

One last example that everyone in America has benefited greatly from is highway safety. The development for highway safety began in the 1960's. After 2 long years of experimentation there was an almost 100% decline in accidents. But then in the 80's there were 400 airline traction related accidents. Looking back, scientists figured out the solution and that was highway grooving. People weren't speeding, cornering abilities were increased, and stopping distances were decreased. This has saved thousands of lives around the world.

Where do we go from here? We don't know; we all have a an idea of what we want to see in the not so distant future, but no one knows what's to come. That's the beauty of technology: it is designing the future for us. We create things today that open up new and different worlds for our future. We've come a long ways in these last 60 years, advancing at an incredible rate, but if it wasn't for curious and outrageous minds, we would still be stuck in the dark ages, lighting our houses with candles.

Julio Bernal
Grade 12
Group Leader

Chapter 6
The Science of Space

A Vast Void

Imagine traveling through outer space and seeing multitudes of stars disappearing into a gap of nothing. Anything that comes near it is immediately sucked in. When you enter it, you are snapped, crushed, stretched, and compacted all at once. The universe is covered in these invisible "death-traps." They are called black holes, and are the interest of curious astronomers, who strive to figure out the mystery of black holes.

Black holes are very compact objects in space with a strong gravitational force, or as explained by Walter Sullivan, "A black hole is an extremely dense concentration of matter equal in mass to millions of suns." No light can come out of them, so they look like pitch-black circles, surrounded by stars. Black holes form when huge stars die and collapse. It is believed that all the objects that have entered a black hole are squashed into the center, taking up the tiniest amount of space possible, which is infinitely tiny. This center is the Central Singularity. The actual size of the black whole itself can range from a few miles to several solar systems, but could possibly be smaller or larger for all we know. The largest ones are called Supermassive, and the smaller ones are called Stellar Mass. It is also believed that at the center of each galaxy is a massive black hole. But how are these beliefs researched and predicted?

Although black holes are impossible to see, stars orbiting and entering them can make them easy to point out. However, this is only easy for finding large black holes. Small black holes suck in fewer stars and therefore emit less light. Astronomers also can detect the radiation wavelengths of black holes using special telescopes, and can detect whether a star is orbiting a black hole or not by measuring the star's speed and light. These telescopes can find not only visible light, but also X-ray waves and radio waves. But even this can only sometimes work, as galaxies that contain huge black holes usually do not form as many stars, so stars orbiting the holes will be harder to see and detect. Galaxies with possibly smaller black holes have more stars, and it is easier to find them.

It is important to detect these black holes and know where they are. As soon as you get even near one, you're a goner, as is any other star, planet, or object that nears it. There is no way out of a black hole and no way to survive in one. Most objects are destroyed before they even enter the hole. Luckily, we have the resources to know where they are and stay away from them. But even if we know how to safely avoid them, that does not help our research of them. Perhaps in the distant future, we may figure out how to safely approach black holes and explore them without being in danger of death. Each black hole is a world of mystery that we may never be able to see. We could be totally wrong about what we think we know about black holes, despite our research. But we may never know.

Lottie Johnston
Grade 10

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Jenny E. Green

Space and Fixed Stars

Fixed Stars are amazing things in the universe. There are numerous stars in the Universe and humans found more than 16 of them and they all make light and energy. The reason why stars make light is because hydrogen and helium create a fusion reaction and energy is the product. in theory, this reaction is a super-sized hydrogen bomb exploding.

They are born when interstellar clouds collapse. Once all the hydrogen in the core is depleted, stars evolve into a red giant. At this stage they release other elements. Stars die sooner when their mass is larger, because it uses more energy to keep the star together. According to NASA stars use 2.5 to 3 times the square of their mass in energy. If a star's mass is small it becomes a neutron star (a star that is very small but has a large mass), but when it's heavier than average, a star will become a black hole.

Our sun is one of the brightest stars in the universe. It is 109 times bigger than the Earth and 330,000 times more massive than the Earth. Also, it counts for the majority of the mass of the solar system. The sun gives solar energy and it makes plants grow by photosynthesis. This gives us the circle of life on Earth. For example, when plants photosynthesize, they will grow, herbivores will eat plants, and carnivores will eat the herbivores.

Fixed stars are very important because they give the possibility that there might be other creatures living in space. If there were no sun, every living organism would disappear. All these reasons are why stars are very important to the human race

Jae Heun Roe
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Space: Where Are We Going

We all may wonder, "How many planets are out there in our solar system?" Well, this first question rose up in the 1700's and it got people to wonder. Finally, in 1781, the second planet to be found in our solar system, (the first being earth) was Uranus. This discovery was made by Sir William Herschel. But, not only did he find Uranus, he found lots of other things, such as 800 double stars, and around 2,500 nebulae. All these findings made Sir William Herschel able to show people why our Milky Way had a spiral structure. Space is a big topic, so I want to talk about how we now look for planets, and what our goals are.

Kepler, a space telescope, was launched on March 7th, 2009 at a cost 550 million dollars. It had an objective to search for planets that were near Earth's size, habitable living circumstances using sizes of orbits, and the density of planets. If Kepler finds any of these planets near a star, it looks at it to determine its composition. A planet that's near a star is in the "Goldilocks" Zone. A Goldilocks planet has a probability of water, and has the right temperature to have life on it which means it needs to be roughly 100 million miles away from a star . But, back when Kepler got put up, it started to have problems with sending its data slowly due to it finding too many "fake" planets (which were asteroids, etc.) and there were too many to take in. They fixed this by changing the processing system and made it stare at certain areas longer to see if they really were planets.

Kepler finds planets by staring at one small area of space for long periods of time and observes little light blips on stars. If there's a repetitive blip every so often, Kepler

marks it as a planet. Currently, Kepler has found 2,740 planets orbiting 2,036 stars, and over 150,000 stars with no planets. Kepler has found 350 planets Earth sized "Goldilocks" planets, 43% of which had multi planet systems. 750 planets are smaller than Earth,816 are supersized Earths, 1290 are Neptune sized, 202 Jupiter sized, and 81 were even larger. Kepler's time in space was set to last 3.5 years, but was extended due to its failures and NASA wanted to collect more information. So, it is currently set to retire in 2016.

On Kepler's missions, it found our closest Goldilocks planet, which is only 600 light years away! This planet is called Kepler 22-b, and it could solve the question of where our nearest aliens live. But, 600 light years is still a very long distance since each light year is 6 trillion miles. This means that, if we wanted to get to that planet, we would have to make food in space out of thin air, make water or liquids that are drinkable, and have multiple generations of a ship. In addition, you would know that you would run into problems along the way, such as asteroids, the ship breaking apart from wear, or even at its speeds, that it could just fall apart!

I think that astronomers just look at what Kepler records and want knowledge on what's out there in the universe. I'm sure that most people know we could not get there, but like to know things that most other people don't think about. Kepler was a big thing and it is used to look for things we'd just dream about. Kepler is very important and we should all use it wisely to our advantage.

Raymond Johnson
Grade 8

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Could there be Life on Europa?

Europa is one of the four Galilean moons of Jupiter. It has recently has been considered to possibly contain life. Europa is a unique moon because of the breakdown of its crust, mantle, and core. Europa has a layer of ice, which covers a deep thawed ocean, a rocky mantle, and an iron core. Its orbit also aids the suspicion of life on Europa. There are a reasonably large number of places that could sustain life in our Solar System and Europa is one of the front-runners.

So, could Europa contain life? The simple answer is yes. Europa is very similar to our moon in a few aspects: they are of a similar size, and both have a locked orbit (meaning that the same side faces the planet during the entirety of its orbit). But our moon doesn't contain life, so why should Europa? A global ocean that could be as deep as 160 kilometers, with a frozen crust that could be a few kilometers thick surrounds Europa, we believe that where there is water, there is a chance at life.

Scientists first became interested in the prospects of life on Europa when they got a closer look. From the outside, Europa looks very similar to the North Pole; the entire surface is covered in icy ridges up to 160 kilometers high. Europa is also lacking something many moons have: impact craters. This is a sign that the crust on Europa is very new, no older than 50 million years old. Scientists soon discovered how unique this is. Because of its elliptical orbit, Europa heats up when it gets closer to Jupiter, and water leaks through the cracks in the moon's surface. When Europa moves away from Jupiter this surface water refreezes. The thawing and refreezing of water is key to sustaining life. Radiation from Jupiter reacts with the ice on Europa, and releases free-form oxygen and other oxidants into its atmosphere. Oxygen gets caught within the ice, and slowly moves into the ocean below, aerating it, and making it possible to sustain life.

Europa is about 780, 000, 000 kilometers from the Sun, which begs the question, "could it be warm enough to sustain life?" The answer again, is yes. Tidal heating of the ocean from Europa's elliptical orbit causes Europa to be warmer than expected given its distance from the sun, and keeps the water on Europa from freezing completely. Though Europa is warm enough to sustain life, there are still problems with its distance from the Sun; underneath the ice, the ocean is pitch black. This makes it impossible for any organisms to photosynthesize.

So if there were life on Europa, how would we prove it? Scientist are already beginning a plan to visit and search for life on Europa: an orbiter is scheduled for 2031 years from now, and a few decades after that, a lander will visit the surface of Europa. Perhaps someone can figure out a way to drill through the ice. But why would we visit the ocean in search of life if you could find life on Europa's surface? Or even without landing on the moon? Searching on the surface and near the cracks for fossils could be a way to find evidence of life in a relatively noninvasive way.

Europa is one of the most likely places in our Solar System to contain life. Scientists looking for life should consider looking on the Galilean moons of Jupiter,

especially Europa. Europa has 'layers'; when looking for life scientists should look one layer at a time so as not to waste time or money searching under the surface for life when there may be evidence of life on the surface, or another 'layer.' The possibility of life on Europa is so high that scientists should continue studying Europa, and eventually pursue this further.

Genevieve Hatfield
Grade 10

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Pulsars – Telling Time and Learning about our Universe

Pulsars are recently discovered, powerful neutron stars in our universe that teach us about universe and help us tell time. Pulsar astronomers have now detected over 1500 pulsars and expect to discover thousands more during the next few years. The Parkes Radio Telescope in Australia has found more than twice as many pulsars as the rest of the world's telescopes put together. The first pulsar was discovered by chance by Jocelyn Bell and Anthony Hewish in 1967. They were actually studying distant galaxies at the time. Jocelyn Bell noticed small pulses of radiation when their telescope was looking at a particular position in the sky. For a short time scientists thought they might be coming from an extra-terrestrial civilization.

Studied further they realized that it was actually a massive stars that had imploded. In other words, it was a pulsar. They are small in size (maybe the size of our city Santa Barbara) but are as dense as a neutron. Pulsars have extremely powerful magnetic fields, much stronger than we can create on earth. In this star, electrons are accelerated to high velocities by these strong electric fields. Radiation in the form of anything from radio emissions to gamma rays is sent out from some place above the star's magnetic field. The star spins extremely fast with a misalignment in the rotation axis and the magnetic axis. From earth we see pulses of the radiation as the star spins, just like a lighthouse sweeps over the ocean.

The time interval between consecutive pulses is called the pulsar's period. Periods of one second are typical although pulsars have been discovered with periods from a few milliseconds up to eight seconds. This regularity is putting earth's atomic clocks to the test. The best pulsars, called millisecond pulsars, are the fastest rotating and keep accurate time to a millionth of a second over a year. If we continue research to ensure long-term stability of these Pulsars, your next wristwatch may be a Pulsar clock!

Other reasons for studying these pulsars include gravity waves. One team, which is led by George Hobbs at CSIRO Astronomy and Space Sciences in Australia, looked at data from the Parkes Pulsar Timing Array (PPTA) project. They use about 20 Pulsars in different parts of the Milky Way to detect gravitational waves. The thought is that when a gravitational wave passes through our galaxy, its presence warps space/time. This warped time can only be detected by clocks from space – pulsars - that are affected by this in a specific way. Gravity waves are ripples in the fabric of space and time. They come from regions of space-time like the very early Universe and the cores of galaxies. So by studying Pulsars we might learn more about the beginnings of our universe.

We use pulsars to study what is in between stars, like the magnetic fields created by galaxies. Also, the motions of pulsars tell us about galactic distribution. Galactic distribution is how stars, planets, and galaxies are located in our universe. By mapping where the Pulsar emits its radiation and where it doesn't we can find hidden objects in space.

These unique small stars hold a lot of information. They are out in our universe for us to study and learn about. By studying them further we may learn more about the beginning of our universe and our clocks have gotten better already. Over all, there is so much we can learn from these stars like measuring time, gravity waves, about galactic distribution, and who knows what else! Because of all this, it is definitely worthwhile to continue studying pulsars.

Lara Kostruba
Grade 9

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The Everyday Use of Relativity

Albert Einstein's "Cosmological Considerations on the General Theory of Relativity" in 1915 enabled the creation of the global positioning system, which is now crucial for the United States government and the world. Einstein's revolutionary equation, E=*mc*^2, E standing for energy, *m* for mass, and c^2 standing for the speed of light, stated energy and mass are related. Originally, this was Einstein's explanation for the stars ability to burn without ever running out of fuel. The speed of light is constant and ultimate, meaning nothing can overtake it. Einstein's theory was simply the understanding of the universe and nature. Although his theories can be difficult to understand, they became very important to the development of G.P.S. by showing the relationship between time and space.

Einstein's theory came from a simple observation of gravity. This sparked the question: if materials are affected by gravity, can light encounter the same difficulty? The factor of gravity was the last aspect included into the "special theory of relativity". At the time, his theory was very obscure to many and only a select few in the world understood him. Relativity explains how both time and space are not limited, but are relative to the observer and the thing being observed. This is affected by speed and velocity of the object. The closer you move to the speed of light, the more slowly time passes. A basic example of relativity is the faster we move, the more distorted we will become, relative to a view from the outside. Although these distortions are clear from the outside, the viewer from the inside does not feel such alterations. The appearance switches; this happens because each viewer's position is relative to the moving object. The theory of relativity states that time is a part of space and is always changing. The two are connected, forming a three-dimensional matrix which is called space-time. When the shape of space-time drags and slopes downward, the byproduct of gravity is formed. Gravity is sometimes thought to not even exist, but is instead the outcome of space-time distortions. Space-time is studied now for the development of G.P.S. using both the special theory of relativity and the general theory of relativity.

G.P.S. provides location and time for systems around the world. The Global Positioning System is maintained by the United States and is used for military, civil, and commercial purposes. There are twenty-four satellites in orbit and they are organized so four satellites are visible at all times. G.P.S. has the ability to detect a position within five to ten meters in a matter of seconds. The purpose of the four-satellite availability is to receive signals from a device, sent to each satellite. Each satellite is necessary in order to have an accurate reading of your location. This accuracy comes from the precision clocks aboard each satellite; this is where they are affected by relativity. These effects make the clocks drag because of the speed at which they are traveling, 8,424 mph, and the distance from the Earth, about 15,960 miles. Einstein's special relativity states that the closer you travel to the speed of light, the slower time passes; this was taken into consideration because the clocks must fall back seven microseconds a day due to the high speeds of the satellites. Without the general theory taken into account, the Global Positioning Stem would be useless. This theory also describes gravitational fields. These fields will cause the clocks to run much slower when closer to a source of gravity. The further away the clock is to the source of field, the faster it will run. Gravitational fields cause the clocks to go at a rate of forty five microseconds faster per day on satellites. Without the use of relativity, G.P.S. would be off by six miles a day. G.P.S. is an example of Einstein's theories which tie together the use of space and time which are used every day and are constantly in action.

Without Einstein's revolutionary theories, the global positioning device would not have been developed. The G.P.S. is a crucial factor to the world governmentally, especially for military purposes. This technique has been adopted throughout the world,

and we have begun to depend on it globally. We wouldn't have an understanding of time, space, light, and gravity if it weren't for Einstein's discovery. G.P.S. has become an everyday luxury for many on a smaller scale than world relations. The global positioning system will constantly be improved and studied in order to make citizens lives easier, as well as global affairs succeed.

Kassidy Hession
Grade 11

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Life on Mars

A huge question to everyone is, "Is there life on Mars?" Mars is a rocky planet with a very similar atmosphere to Earth's. We know it as "The Red Planet" as well because of its rocky, red surface. There have been many things that indicate that there most likely has been water on Mars, so that could mean that there was once life on Mars, because life needs water to survive. We sent rovers that collected samples and did all sorts of tests to find an answer. Even though the evidence points out that there was once life on Mars, we still are discovering new things to be absolutely certain.

From what we have seen, there is no water currently on Mars. However there is evidence that there was once water on Mars a long time ago. The atmosphere used to be thicker around Mars and it used to be a wet planet with warmer temperatures than it has today. Because of the thicker atmosphere, Mars had the Greenhouse effect, which warmed the planet and allowed ground water to remain unfrozen. Gullies on Mars suggest ground water was there, although some people think they were formed from underground water. So far, experiments have shown that there are traces of minerals left behind in the gullies, which suggest there could possibly have been life on Mars.

Mars is now a dry, frozen planet, and there is little evidence to support that there is water on it today. NASA now has evidence from gullies that water carried sediment on Mars in the last seven years. This is the strongest evidence that water may still flow occasionally on Mars. Water on Mars suggests that there may have been life on Mars once. There are craters suggesting that water flowed under Mars surface and so there may have been microscopic life. So any life probably started below the surface. The craters contain clay and carbonate on their sidewalls; these substances may form after contact with water that suggests that there may have been life on Mars once. Water would mean life because all life needs water to survive and if there is water it is, of course, very likely that there are organisms in it.

Methane on Mars suggests that there could be life on Mars because the gas is biotic, or made by living things. It could be gas residue of living things from a long time ago or it could be from things alive today. Researches were able to show that the methane actually escaped from a meteorite so the methane was not from the planet. But if the methane remains constant, it means that the methane could be from extraterrestrial life on Mars.

In conclusion, Mars has had many different scientists discover things about the planet and connect them to life on Mars. Some of them were proven and some had other explanations than life. Right now water is our best bet for knowing whether there was life on Mars once or if there still is. We will always be discovering new things that will either make our predictions true or make us think again and come up with new things to test, but life on Mars is most definitely possible. I personally believe that the study of Mars should continue to be funded because we should continue to learn about what is all around us. There is so much out there and, the more we can learn about other planets, the more we can know about how to keep ours healthy and the more we can understand Earth.

Hazel Brady
Grade 10

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Life Cycle of Star

A star is a ball of gas that fuses its own energy. Every star is different in its size and temperature. The life cycle of a star is long and complex. There are three main parts of a star's life: birth, middle age, and death. Stars are important because they are an amusement to humans, they give off light, and without them, we cannot live.

A nebula is where the star is born. A nebula is made up of dist and gases. There are different types of nebulas for different types of stars. Stars form in a cloud of gas and dust inside the nebula. A proto star is the beginning of a star's life.

The middle age of a star is the longest stage in a star's life. The main sequence of a star lasts about 10 billion years. During that time, the outflow of energy from the middle regions of the star keeps the pressure necessary to keep the star from being sucked in by gravity under its own mass. The star must keep equilibrium. This means a star has to keep its balance between gravity and force. After a long period of time the star becomes old and cannot keep its equilibrium. When it gets older, it changes temperature and when it does, the equilibrium changes or goes away. This is one of the first stages of a star's death.

The length and life of a star is determined by its mass. When it has used all of its hydrogen, it stops producing energy. When that happens, the star collapses, but hydrogen fusion continues. Eventually, this transforms a star into a Red Giant. After this, depending on the size of the star, it eventually dies. A massive star explodes and can form a black hole. The explosion is called a supernova. A smaller star will cool off and then stops glowing.

Why does it matter? It matters because we cannot live without stars. The Sun is a star and without the Sun, we cannot live. For example, plants need the sun for photosynthesis. It gives off heat and light which are both necessary for life. Also, the many expeditions undertaken by numerous explorers were guided by the stars. Simply put, the earth and everything as we know it would be completely different without stars, maybe to the point of being lifeless.

August Baxis
Grade 7

An Overview of Space Science and Technology

My group was given the task of looking at the science and technology of space and discussing whether or not it is worthwhile to continue space exploration. Topics covered include: the Kepler space telescope, life on mars, life on Europa, the life of stars, our sun, pulsars, black holes, and Einstein's theories of relativity and space-time.

The Kepler space observatory was sent up by NASA in 2009 to try and identify planets in the "goldilocks" zone. The goldilocks zone is the area around a star at which it is possible for life to exist, where the temperature and other conditions are "just right." Kepler looks for planets by staring at one part of the night's sky for years at a time and monitors the light coming from stars. It looks for a dark spot moving across the light of a star. When Kepler was first sent up it would accidentally pick up other space objects, like asteroids, but was recalibrated so that it would look for longer and must see then object reappear at regular intervals to prove that it is a planet orbiting a star and not just an anomaly. Kepler has discovered 2,740 planets orbiting 2,036 stars, and over 150,000 stars with no planets.

The topic of life on Mars is one that has long been discussed among experts and "experts." Mars may have once had liquid water as recently as 7 years ago, and may again in the future. It used to have a thicker atmosphere that would have had a greenhouse effect. We are continuing sending probes and rovers to the surface, and are working on sending a human to Mars soon.

Europa is one of Jupiter's four moons. It has an ice crust and an ocean with an iron core. Its orbit and the composition of its crust could be key factors in determining whether there is life on Europa or not. Scientists are planning probe missions to Europa in the next 20 years.

Stars, like our sun, have life cycles. They are formed in Nebulae. The dust in space gathers together and, through the force of gravity, compress together to create chemical reactions that release energy. This is the middle age of the star, and lasts for billions of years. When a star begins to run out of fuel, it compresses down further and the reactions start again. Eventually it can compress too far and create a black hole. Or, sometimes, it will explode because the energy is too high and will create a supernova, which will then create a nebula and can create more stars or planets.

Pulsars are high energy stars that are rotating around an axis. They emit radio and magnetic wave for their energy and motion. These emissions come from points that are not aligned with the rotational axis and therefore spin around. We can monitor them from earth with radio satellites a measure the blips as the pulsar spins. They are great natural clocks; the faster they spin the more accurate they are. Millisecond stars can keep time accurate to a millionth of a second. Because they can detect such small changes in time, we can use them to measure the effect of gravity waves, which are ripples in the fabric of space-time, because of gravity's relationship with time as described by Einstein's theories of relativity.

A black hole is an infinitely dense piece of matter. They are created in the death of stars. They create a gravitational field so strong that not even light can escape and bend space-time.

All of these researches have lead to major innovations in the world today. Many computer technologies, and GPS, all have theirs foundations and creations in the science of space, which is why space exploration should continue, if not to find other places to live or extra terrestrials, then to aid progress here on earth.

Patrick Alcerro
Grade 12
Group Leader

Chapter 7
The Cost of Space Exploration

The Curiosity Rover

On July 20, 1969, a young thirteen year old boy named Steve Squyres watched in wonder as the first astronauts landed on the Moon. Since then, Steve had been fascinated by space. In 1971, Steve as a student was really interested in being a geologist, but he soon realized that most of the rocks on earth had been discovered already and there was nothing new. That was when Steve decided to get more into space.

In 1976, the Viking I and II took pictures of Mars while orbiting, and Steve was taking a class on space at Cornell University. Steve became so interested in space that he actually asked for a key to the Mars room, a storage space with shelves of three-ring binders and rolls of photographic paper with images from the Viking mission.

The Spirit and Opportunity rovers, developed by Steve Squyres, were the first two rovers to explore Mars. By the end, the two Rovers, Spirit and Opportunity, traveled

longer and stayed powered for longer than anyone expected them to live. Their success was the inspiration for sending the Curiosity Rover to Mars. (Rusch)

Curiosity is a car-sized, solar powered rover that was launched at Cape Canaveral on November 26, 2011, aboard the NASA's Mars Science Laboratory (MSL) and landed successfully on Aeolis Palus in Gale Crater on Mars on August 6, 2012. Curiosity's mass is 899 kg of scientific instruments including a length of 9.5 feet, a width of 8.9 feet, and a height of 7.2 feet.

The Curiosity's goals include: an investigation of Martian climate and geology, whether or not the field site inside Gale crater has ever offered environmental conditions for microscopic life, an investigation of the role of water, and collecting information from Martian soil. The mission will also help prepare for human exploration. The space craft had the mission of delivering rover from earth to Mars. Curiosity's power source is a radioisotope thermoelectric generator.

The latest price tag for NASA was $2.5 billion, making it the most expensive mission to Mars yet. If you broke it down, it would cost every American $8 for one mission to Mars. In addition, nine months before its scheduled launch, the space agency said the mission had spent all of its reserves and needed an extra $82 million to complete testing before liftoff.

President Barack Obama has proposed keeping NASA's overall budget at $17.7 billion for next year, but is decreasing NASA's Mars exploration program budget from $587 million to $360 million next year. As a result of these cuts, there are limits on what the Rover and NASA will be able to do on the surface of the Red Planet. Also, NASA's last-minute withdrawal from the joint-European ExoMars and TraceGas Orbiter missions last year was due to unexpected budget cuts.

When NASA announced the 2020 plans to go to Mars, planetary scientists were concerned about the rest of the solar system being left out. Jim Green, head of NASA's planetary science division said "we were given the opportunity- to define strategically what that mission was to be, or we would potentially lose the money." (Space Politics)

Whether or not the Mars exploration gets funded really depends on how important people think it is. Because of the successful landing of the Curiosity Rover, some have wondered if the public's interest in the mission will translate into additional funding. The landing also prompted a statement from President Obama, who called the landing "an unprecedented feat of technology that will stand as a point of national pride far into the future." While there's no question the federal government must cut spending and reduce the deficit, it must be careful about gutting investments that yield important payoffs.

Curiosity has two sensors that were developed by two brothers who were graduates of Lawrence Technology University and manufactured by FUTEK Advanced Sensor Technology Inc. of Irvine California. Just last month, scientists had identified the main chemical ingredients for life. Curiosity had drilled it out of a sedimentary rock by an

ancient stream bed in Gale Crater. Michael Meyer, lead scientist for NASA's Mars Exploration Program said, "Mars has written its autobiography in the rocks of Gale Crater, and we've just started deciphering that story." The main question for the mission was weather Mars could have ever supported a habitable environment. According to what Curiosity has discovered, the answer is yes.

Alec Sherwin
Grade 9

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NASA Funds America's Future

NASA's mission statement is, "To reach for new heights and reveal the unknown so that what we do and learn will benefit all humankind." (nasa.gov/about) To this end NASA gives financial aid to a variety institutions of learning.

NASA funds many educational programs. NASA spent 145.4 million dollars on education in 2011 and about 136.1 million dollars in 2012. NASA estimates that they will spend only 100 million dollars annually from 2013 to at least 2017. Education is one of the lowest funded categories for NASA. The only other category that receives less funding than education is the Office of Inspector General, which received 36.3 million dollars in 2011 and it has only gone up slightly since then.

NASA is funded by the federal government and it is considered to be in the category of discretionary funding, which also covers defense and non-defense programs such as veterans benefits, health, and educational spending. It had requested 100 million dollars for 2013 for education, and Congress was going to give them 137 million dollars. However, with the sequestration cuts they have had to cut 7 million dollars from that funding, so now funding for education is getting 130 million dollars, which is still more than it had requested. NASA is trying hard to still honor their grants to all students, teachers, and organizations.

NASA's funding for education mostly goes to grants for college students who work in science, technology, engineering, and mathematics also known as STEM education. NASA provides internships and fellowships to high school, undergraduate and graduate students. They provide funding for college educators as well.

"Through the SoI Mini-Grant Program organizations will be able to apply for funding up to $2,500 to integrate SoI themes and content into existing middle-school student or teacher centered summer or after-school programs. Eligible programs would contain one or both of the following in their application:

1. The delivery of at least 6 hours of NASA SoI content targeting underserved and underrepresented middle school students in summer or afterschool programs.
2. The delivery of educator workshops (for certified teachers, pre-service teachers or informal education community) featuring NASA SoI content or themes." (soi.spacegrant.)

In addition to the SoI (Summer of Innovation) mini grant programs, NASA has been working to expand its other education programs. "In 2010, NASA chartered an Education Design Team (EDT) to develop a strategy to improve NASA's education offerings, assist in establishing goals, structures, processes, and evaluative techniques to implement new sustainable and innovative STEM education programs." (nasa.gov/home/)

In addition to traditional education funding through schools, NASA also funds over 400 museums and science centers that use NASA resources in their educational programs and exhibits.

"Congress's Appropriations Conference Reports in FY 2008-2010 also reallocated the NASA Office of Education's budget to support 'educational activities in science, technology, engineering and mathematics, including exhibits' at NASA centers (including the Jet Propulsion Laboratory) and the NASA Visitors Centers. Some NASA centers operate their own visitor centers, and others have space act agreements, grants, cooperative agreements or contracts with private commercial firms, local museums, or not-for-profit organizations to support NASA-related informal and formal learning." (Budget estimates, nasa.gov)

To inspire students, it uses non-traditional resources to provide mission focused educational opportunities with engineering challenges and contests as well as simulations. NASA mostly gives funding to graduate and undergraduate students, they give very little funding to K-12 students.

For the fiscal year of 2012 NASA education programs included: National Space Grant College and Fellowship Program (Space Grant). "Space Grant supports and enhances science and engineering education and research efforts in higher education, K-12 and informal education." (nasa.gov/pdf/516643) Experimental Program to Stimulate Competitive Research (EPSCoR), funding is awarded to lead academic institutions to give opportunities for teachers and research teams to work on research and technology development. Emporia State University in Emporia Kansas was selected as a joint venture institution by NASA. This selection led to programs that study climate through satellite imagery as well as to study the evolution of stars. Other grants and programs include the Steckler space grant which gives up to $70,000 to chosen universities to study the long term human presence in space. The University of California, San Diego was one

of the grant recipients. NASA granted $200,000 per year for up to three years to Debbie Senesky of Stanford University, a faculty researcher in the use of instruments in the harsh environment of space. An assistant physics professor at Arizona State University was given a very large grant to do research. "(Professor) Deng's knowledge of physics helped her receive a $408,000 NASA grant toward the development of a 3-D device, which will be able to view how solar wind energy passes through the Earth's upper atmosphere."(theshorthorn.com) These are just a few of the people and universities which benefit from the grants that NASA gives out, not to mention all the people who will benefit from their discoveries.

Education is very important and of all of NASA's programs, it is a shame that educational programs get the least funding. It's really important for children across America to have the same opportunities that we had at Anacapa School to meet experts working in space and on the ground in STEM programs. The Arizona Space Grant Consortium is helping make this possible."The AZSGC mission is to expand opportunities for Americans to learn about and participate in NASA's aeronautics and space programs by supporting and enhancing science, and engineering education, research, and delivering high quality public education programs. Our goal is to integrate research with education to help build a diverse, scientifically literate citizenry and a well-prepared science, engineering and technology workforce." (spacegrant.arizona)

We need more programs like this, that are working with middle school and high school students to get them interested in these fields. With additional funding spent on STEM education, we can develop a stronger work force that has better knowledge of science, technology, engineering and mathematics. This will help the whole country because the U.S. is way behind many other countries in these areas of education. Out of 12 wealthiest nations the United States spends more money on education per student yet we lag behind in 10th place in mathematics and 9th place in science. If we could educate more effectively in the STEM areas it would help drive us further into space.

Elena Alcerro
Grade 8

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The Orion

The Journey into the Beyond

Exploration in space has become a widely controversial topic. Many United States citizens want to explore the universe around us, but don’t want to spend money that the government does not have. Currently, the Orion, a NASA spacecraft is being built to explore deeper into space. Budgeted through the space exploration system in our government, Orion will be a transformational experiment. In order to know what lies in the solar system, we must be able to have the money to explore it.

The Orion is a multi purpose crew vehicle that is planned to orbit the earth. It is a manned spacecraft being built by Lockheed Martin for NASA, that will be used for crewed missions to the Moon, asteroids, and Mars. It is planned to be launched by the Space Launch System and each spacecraft will carry a crew of four or more astronauts, along with ISS cargo (NASA). The Orion has many intricate capabilities. The Orion has a launch abort system, which is positioned on a tower atop the crew module and can activate within milliseconds to pull crew to safety. The service module provides support to the crew module all the way from launch until re entry. It provides in space propulsion capability for orbital transfer, attitude control, and high altitude ascent aborts. In conjunction with the crew module, it provides water, oxygen, and nitrogen to support the living environment of the crew module (NASA). The Orion is an extremely marketable vehicle and project – as it targets commercial space flight as well as scientific exploration.

The Orion is not only a plan that will bring vast, otherwise unknown knowledge to the United States – but it is also economically productive. Lockhead Martine (alone) employs six hundred and fifty people to work on the Orion project – but their employment system extends throughout the entire nation! (“Funds Cut”) In 2010, Lockhead Martin reported that nearly 4,000 people and 100 companies had worked on the Orion thus far. This number is significant for the high unemployment rate that our country faces today. NASA even reported that the Orion’s human commercial space flight division would create *at least* 5,000 jobs in this country! (“Orion: Spacecraft”) Although the Orion project, along with other NASA projects are technically out of our country’s budget – the economic and academic benefits are endless.

Continued space exploration such as the Orion project is controversial due to budget challenges. According to NASA, the United States government annual budget directed towards space exploration is 17 billion dollars. 3.28 billion dollars in specifically coming from the state of California – which is already struggling financially (NASA).

President Barack Obama has acknowledged that in the near future, he would like 3.9 billion dollars of the federal budget to go towards space exploration, alone. Specifically, Obama would prefer if 829.7 million dollars, of the federal budget go towards commercial space flight, alone (NASA).

In a time of extreme fiscal issues, it would be dangerous to only put United States money into further exploration. As it is an important component, it would be more fiscally conservative to join forces with various countries who, too, would like to explore deeper into space but in a financially conservative manor. In this scenario, the United States would also gain technological knowledge from other countries, in areas that we lack. For instance, Russia has had less lethal human space exploration fatalities than the United States, and if we were to join forces financially with them, we would be able to gain knowledge in the safety and sturdy division of space exploration. This partnership would be similar to the international relationship that the United States has with the International Space Station. In regards to the Orion, the international concept has not been suggested yet. The structure of this international partnership could be very similar to that of the International Space Station. Basically, each country partaking would be benefiting from not taking complete financial responsibility of a project that is, in essence, unpredictable. In addition, each country has technical knowledge that is unknown to the other partaking countries. If this knowledge was shared, it would not only benefit the government of each country – but the entirety of the Orion project.

The Orion's multipurpose ability to incorporate space exploration and commercial space flight is a very marketable plan. As the budget circumstances are controversial and temporary, it is important to develop an intricate plan as to how to further space exploration within the United States federal budget.

Aija Mayrock
11th Grade

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SpaceX (Space Exploration Technologies)

SpaceX was founded in June 2002 by PayPal and Tesla Motors co-founder, Elon Musk (born June 28, 1971). This company has grown very rapidly and its employee numbers show that they are here to make their mark on the world. Since November of 2005 they had 160 employees and they now have over 1,100 employees, which means there are a lot of men and women helping America reach space. Mr. Musk's personal goal is to have human exploration and settlement on planet Mars; he wants humans to be able step foot on Mars in the next 10 to 20 years. SpaceX is the first private company to send cargo to and from the International Space Station. SpaceX is the world's fastest-growing provider of launch services. With nearly 50 launches in its history, representing more than $4 billion in contracts, SpaceX continues to push the borders of space technology through its Falcon launch vehicles and Dragon Spacecraft (spacex.com).

This company has operated on only $1 billion dollars in the first ten years of its operation, compared to NASA using $3 billion on the James Webb Telescope which is only one project. The reason for SpaceX's $1 billion dollar expenses is due to three rocket engines, Merlin, Kestril and Draco, which were developed with private money.

SpaceX's funding sources are private equity funders who provided $200 million and Musk himself provided $100 million. Investors provided another $100 million, and NASA has funded $400-$500 million dollars for this remarkable company. It also operates on contracts from companies like NASA.

The benefits of this company in my mind are that American contractors of the supplies and materials needed to make this company's products are boosting our economy. (And a big boost is that this company could handle getting the food and supplies to the ISS, while the other scientists can discover new things in space.) Another benefit is that a company like SpaceX can have researchers working in other countries so they can have all the brightest minds working to make space settlement possible. This gives humans the opportunities to discover space beyond planet Earth.

My recommendations to this company are to keep achieving its goals and pushing everything to further explore space. This company should use its resources to employ extra workers, which will help unemployed people by making some money and not living off a check from the government.

Alexander Brand
Grade 7

Sources

wikipedia.org/wiki/SpaceX

spacex.com

Human Space Flight Operation Economics

NASA'S Human Exploration and operations mission oversees human exploration in low Earth orbit. This section of NASA also includes the management of Space Life Sciences Research and Applications, Advanced Exploration Systems, Human Space Flight Capabilities, Exploration Systems Development and Commercial Space Transportation.

In 2011 NASA spent 18.4 billion dollars. In 2012 they had a budget of about 17.8 billion dollars, and now in 2013 they cut down to about 17.7 billion dollars. They spend about 1,167 million on exploration systems, 2,818 million on space operations, 45 million on space technology, 20 million on science, 363 million on cross agency support, 1 million on education, and 49 million on construction and environmental issues.

NASA spends about 7.9 billion on human spaceflight. 38% goes to the international space station, 4% goes to exploration research and development, 35% goes to exploration systems and development, 12% goes to space and flight support or the SFS, and last they give 10% to commercial spaceflight companies like Space X. (http://www.nasa.gov/)

The Blue Origin is a commercial space program that takes people who can pay up into space. The program was created by Jeff Bezos, the owner of Amazon. The program is funded also by NASA. NASA has given about $22 million to the Blue Origin. They are giving it because they believe there is a potential for commercial human spaceflight. The Blue Origin is hiring people who have decent credentials and a passion for space. (http://www.blueorigin.com)(bizjournals.com)

Elijah Whitney
Grade 8

The Hubble and Kepler Telescopes

Hubble: The Hubble is a high-powered telescope that can take Photos of things in space from light years away. The Hubble is about 354 miles from earth in Earth's orbit and the Hubble's speed is 4.56 mps. It was launched on April 24, 1990 at 8:33 AM at a

cost of $2.5 billion in 1990. With repairs and upkeep, it has cost $10 billion in United States dollars as of 2010. The Hubble's mission length is 22 years, 10 months, and 19 days. Its mass is 24,500 pounds and it is 43 feet long. It is intended to be used at least until 2013, then it will be replaced by the James Webb Space Telescope in 2018 (wikipedia.org).

The Hubble was envisioned in 1923 when Hermann Oberth, the father of modern rocketry, Robert Goddard and Konstantin Tsiolkovsky published a paper about how a telescope could be sent into orbit. The reason it is named after Edwin Hubbleis he was the astronomer who proved that the universe is expanding. He tried to make the Hubble a reality in the 1970's. After its launch, the Hubble was a laughing stock because the mirror wasn't quite right which produced faulty or blurry photos. The mirror was fixed 3½ years later, and since the, the Hubble has helped astronomers figure out and change theories, such as how old the universe is. As Mary Virginia Fox noted in her biography of Edwin Hubble called American Astronomer, published in 1997, the Hubble has helped us see that ". . . we are part of a universe in which our Milky Way is but one of a thousand (now revised to several billion) other galaxies." In short, the Hubble has helped us to know more and understand more about the universe.

Funding was difficult. At first, Congress forced them to scale back their vision but gave them money for a proposed launch in 1983. Then with the Challenger disaster of 1986, all space programs were put on hold. Many of the astronomers where dedicated to this and they personally visited their congressmen and wrote letters to them. They were able to obtain funding from Congress and in collaboration with the European Space Agency, because funding has been challenging (no pun). The Hubble is actually smaller than it was originally supposed to be. The Hubble finally launched in 1990. It has had 5 servicing missions since then for upkeep and repairs. The Hubble is able to take very accurate, detailed images of deep space nebulas, distant galaxies, and other beautiful thing in space. By launching the telescope into Earth's orbit, it removed its most significant obstacle: the Earth's atmosphere. Since the atmosphere is not in the way, the Hubble can look straight through the void of space. That is why the Hubble can take such awesome pictures. The Hubble is NASA's most successful telescope. It has helped to make a more accurate estimate of the age of the universe. It has shown the way the galaxies evolve. The Hubble's impact on science is unprecedented. It has provided never-before-=seen images of the universe. Many independent contractors have been involved in each stage, from building the evaluation and future recommendations and especially in designing the observatories and space centers.

Kepler: The Kepler is a telescope that can study stars and see if there are any changes in light. The Kepler is about 92,955,807 miles away from Earth and the Kepler's speed is 3.661 mph. It was launched on March 7, 2009 at 3:49 AM at a cost of $550 billiion in United States dollars. The Kepler's mission length is 7.5 years. It was named for Johannes Kepler, an astronomer from the 17th Century. Kepler was so unique in many ways. He was know for making astronomy fun and for some of his discoveries such as the 3 Laws of Planetary Motion which they thought was a breakthrough. He actually saw a comet firsthand when he was about 6 years old and a lunar eclipse when he was about 9

years old. Galileo Galilei was a contemporary of his. You have probably heard Kepler's famous quote: "I much prefer the sharpest criticism of a single intelligent man to the thoughtless approval of the masses." No wonder NASA decided to honor him by naming a telescope after him.

Funding was tough, again due to budget cuts, but at last Congress approved original funding and the initial cost was about $600 million. NASA has said that the Kepler is funded until 2013, longer than its 3 ½ years of estimated operation. However, an independent panel of NASA scientists recommended that the Kepler Telescope be funded through 2016. The Kepler is based at The Ames Research Center in Mountain View, California, which is only about 4 hours north of Santa Barbara. The Kepler is considered to be inexpensive by NASA standards, and it is nice for public involvement that it has an observatory. The Kepler focuses on the Milky Way and has missions studying the faintness or brightness of different planets, and finding previously unknown planets. And they get to use cool terms like "stellar objects." Sometimes NASA withholds information discovered by the Kepler for up to three years which gives their astronomers a chance to study the validity of the information before releasing it to the public. This is an interesting time to be an astronomer. I'm so glad to learn aboubt space and to start to understand what all this means. A benefit of the Kepler mission is that it could help us find life on distant planets, if there is any. I think, with this mission, we will finally have proof that there is life on other planets.

Randy Ross
Grade 7

Sources

wikipedia.org/wiki/HubbleSpaceTelescope
wikipedia.org/wiki/Kepler
sfgate.com/science/article/NASA-extends-planet-hunting-Kepler-mission-3460402

LANDSAT and TOPS

They say a picture is worth a thousand words, but is a picture worth 855 million dollars? NASA's Landsat Program is an electronic eye that orbits the earth taking pictures of the earth's terrain. While many scientific programs find the pictures useful in their research, others ask is its expense necessary.

Unlike most NASA satellites, which turn their lenses toward the heavens, Landsat points its lenses toward earth. Landsat orbits the earth 570 miles above us, constantly taking pictures that are used to help the government monitor the changes on earth. Landsat takes pictures of the same regions over a period of time and allows scientists and government officials to observe population growth, environmental changes and development over time. This great asset to the people of earth does not come free, though.

Landsat has been in orbit since 1972, collecting information about the earth's environmental and topographic changes. With the Landsat pictures, NASA is able to study dynamic changes caused by humans or natural process on the earth. These changes are observed by comparing photos previously taken by Landsat with the most current photographs of the same region. This time-lapse photographic process allows scientists to compare how natural events and population growth have and will affect a region.

Even though the Landsat program is over four decades old, it is still an effective tool used by scientist and the Government. On February 11, 2013, NASA launched the Landsat Data Continuity Mission (LDCM) on a United Launch Alliance Atlas 5 rocket from Vandenberg Air Force base in California. This mission cost eight hundred and fifty five million dollars, and is the last mission for this forty-year-old program. The mission's objectives are to use Landsat to get quality data that meets NASA's and the USGS's requirements for observing the planet's resources, environmental changes and land use.

"We collect data with a spatial resolution of 30 meters, that is, every picture element or pixel in a Landsat image represents an area approximately 100 feet by 100 feet. That's about the size of a baseball diamond." **(**Jim Irons, LDCM project scientist, in CNET)

Landsat is also working on another project while in orbit. The NASA satellite will be providing growers in the San Joaquin Valley important information about their crops. This data will be used to provide the farmers with pictures of their crops and the surrounding resources throughout the growing season. Most of the growers in this region produce wine, so in a way NASA is helping make wine. The growers know how much water their crops need each season, but NASA is hoping to provide them with that extra bit of information so they can get the most out of that precious resource. To determine the crops' water needs, NASA uses a system called Terrestrial Observation and Prediction System (TOPS). TOPS combines the data from the NASA satellites and data from weather stations to efficiently determine which crops are looking thirsty and which crops could go without water. NASA has put the Landsat and TOPS programs to good use for the environment. In this world, where fresh water is scarce, and where agriculture proves to be the largest industry, every drop must be accounted for and used efficiently.

While some people believe that scientists should focus on finding our next planetary resource in outer space, others believe that they should turn their focus back towards the earth. The Landsat and TOPS programs are clear indications that NASA believes that we should focus on the earth. While Landsat missions are very expensive, the possible benefits are worth the large price tag. The money we put into Landsat is paid

off; we are saving money with its information. The budget request for NASA's Science Research for 2013 is 4911.2 million dollars. For Earth Science, which includes Landsat, it is 1,784.8 million dollars. And for the Landsat Data Continuity Mission, the budget request is 54.7 million dollars for 2013. No price is too great to protect our planet and natural resources for future generations to come.

Henry Johnston
Grade 12
Group Leader

Even if you're on the right track, you'll get run over if you just sit there. - Will Rogers, American Humorist, 1879-1935

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QUOTES

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http://earthobservatory.nasa.gov/blogs/fromthefield/2013/02/09/the-landsat-8-launch-in-quotes/ (Jim Irons, project scientist)

Heliophysics and Our Future

The study of the connection between the sun and our Earth is known as Heliophysics. The sun is our closest star, which gives scientists the opportunity to closely examine its traits and its effects on the universe. It has the ability to manipulate life on earth and what we know about the solar system itself. It is extremely important to continue research in order to understand its realistic effects on the earth it may have in the future.

Although it seems that Earth is a great distance from the sun, it is 93,000,000 miles away. This means that the sun's solar winds and flares do disturb Earth and the solar system. Destruction of Earth's magnetic field and climate system would be due to massive solar wind and radiation. Solar wind is made up of electrically charged particles with enough power to blow outwards towards Earth and other planets. Solar flares increase the winds with enough power to disrupt power grids, telecommunications and GPS devices. Accumulative data and research can contribute to the prediction of solar weather so that we are better able to adapt to its effects.

The job of NASA's Heliophysics Science Division is to research and collect data on the sun and its interactions with Earth, other planets and interstellar gas. Changing environmental conditions in the heliosphere--the extended solar system environment-- can greatly affect our planet. Under this division, scientists develop models, spacecraft missions, instruments and data systems that are capable of new possible discoveries. It is their job to collect, observe, analyze and publish data and results.

The government funds NASA and its exploration programs, as well as many space education and outreach programs. The Advanced Composition Explorer (ACE) is part of the NASA Explorer Program, specifically a project of the Solar and Space Exploration Division. Its job is to study matter from energized particles in solar wind and interplanetary medium. A reliable source concludes that the objectives of the Advanced Composition Explorer are to "…measure and compare the composition of several samples of matter…" (NASA Science Missions, www.science.nasa.gov). It is used by the Space Weather Prediction Center to improve forecast and warnings of solar storms. It has proven to be effective and can benefit the future of our Earth. With its findings, knowledge about the sun's activity can be used to predict future scares that could lead to problems on Earth. It was launched August 5, 1997, and will remain in orbit until 2024. ACE was funded by 27 contracts with a total obligated price of $11,812,959. Although an expensive project, ACE is a significant assignment that contributes to protecting our Earth and preserving it for the future.

Space exploration regarding heliophysics is costly but necessary. It is extremely important that the human race continues to observe and record the sun's involvement in our solar system. With information gathered from missions regarding heliophysics, we are able to prepare for the possibility of mass extinction and global warming. Global warming poses a huge threat to Earth and with continuous study of the sun, we are better able to understand and manage the situation. It is no wonder that NASA requests and uses such a great amount of government funds to support their research and missions. NASA divides the Heliophysics Department into four subdivisions: Research and Analysis, Sounding Rockets, Research Range and Missions/Data Analysis. Costs are distributed according to the FY request. In 2011, NASA used a total of $639 million dollars to fund the entire heliophysics department alone. In 2012, an estimated $620 million dollars was necessary in this division. Currently, NASA hopes to receive $647 million dollars for the year 2013 in order to fund current and future exploration missions. A portion of this comes from taxpayers. U.S. Federal Spending divides up its expenses into portions that are essential to

American citizens as well as portions that can be cut as needed. Expenditures that are difficult to cut include Medicare/Medicaid, Social Security and the Defense Department. This can be debated from many angles, but government funding to continue space exploration is immensely important in the future of Earth and the human race.

Shayna Smith
Grade 11
Group Leader

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Govbudgets.com. "NASA's Budget: Heliophysics Research Program." www.govebudgets.com/program/science/Heliophysics/Heliophysics_Research.-NASABudget:HeliophysicsResearchProgram

Dr. Peter V. Foukal. "Heliophysics Inc." www.heliophysics.com-HelioPhysicsInc.

The International Space Station: Is It Worth It?

The International Space Station (ISS) was launched on November 20, 1988 and operates as a satellite, currently in low Earth orbit. The ISS is funded and maintained by a collaboration of agencies worldwide. These corporations include the U.S. (NASA), Russia (RFSA), Europe (ESA) and Japan (JAXA). When a contract ended between RFSA and NASA, Russia implemented a new deal that allowed NASA to buy spots on Soyuz for $21 million dollars. The European Space Agency has committed to paying $8 billion of the total estimated price-$100 billion. Most of the portion to the ISS contributed by the ESA is made up of funds from Germany, Italy and France. The ISS orbits the Earth 15.7 times a day at roughly 17,500 mph. It has been continuously crewed since November of 2000 with visits by its international managers and a total of 204 individuals. Composed of multiple parts, the ISS weighs around 861,804 pounds and is expected to weigh closer to 1,000,000 pounds when finished. It not only serves as the largest manmade object to orbit Earth, but as an habitable space facility for research and observation.

The International Space Station is politically complex because not only are its elements not integrated until they are in orbit, but organizations over the globe are profoundly involved. NASA is inclined to invest in the ongoing expenses of the ISS and will continue to do so at least until the year 2017, the project's initial end date. NASA enacted the Space Act Agreements stating financial and intellectual aid from 7 private firms and 2 universities. NASA estimates that U.S. taxpayers alone have composed a total of $50 billion dollars since 1994 and a total of $100 billion by all member nations. President Obama recently signed a bill to extend the ISS mission to the year 2020, aiming for a trip to an asteroid, an idea proposed by President Barack Obama, in 2025. According to online source *USA Today,* President Obama released a "…federal budget proposal for 2014, which requests $17.7 billion for the space agency , up from the $16.6 billion that Congress eventually approved for last year's budget." (Dan Vergano. USA Today). The purpose of this project is to 'lasso' an asteroid already close to earth, and place it into the moon's orbit so that astronauts are able to visit it. NASA alone required $2.7 million dollars (2011) to maintain the ISS, this amount increased to $2.8 million in the year 2012. Presently, NASA requests an average $3 million for operations involving the space station during 2013. A current estimate of the absolute price at the end of the project is between $35 and $100 billion U.S. dollars. This dramatic range is due to the undefined term that the ISS is predicted to operate; the longer it is active, the higher the price tag will be. As the numbers add up, members of all collaborating nations can only hope that the cost is worth it.

The International Space Station functions as a laboratory and observatory base. It is a possible staging center for transport and maintenance during future missions. With over 400 experiments on biology, human physiology, physical, material, space and Earth science, many contributions have been made by the research done onboard the ISS. It is important that we continue operation of the ISS in order to encourage long term exploration of deep space and to advance in medicine, technology and science here on Earth. Study of zero gravity effects on humans on the ISS has been helpful in improving disease treatment. Scientists can better understand and mitigate muscle, balance and bone difference between life in space and on Earth. Research done on the space station on human health can give us a broader understanding of injury and disease and the information we need to greater benefit human life. If funding of the International Space Station is continued, we would be able to make adjustments for further explorations, human and robotic missions, farther, faster and longer duration projects in space by experience with the station. The ISS gives us better knowledge of life away from Earth and environments outside of our planet. It is necessary to continue performance on the International Space Station so that we can develop new technology and projects to take us to new frontiers in the near future.

Shayna Smith
Grade 11
Group Leader

Sources

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What The International Space Station (ISS) Cost To Build. historical.whatitcosts.com/facts-space-station.htm

Is the International Space Station worth $100 Billion? www.space.com/9435-international-space-station

What is the Purpose of the Space Station? www.pbs.org/spacestation/station/purpose.htm

International Space Station (ISS) Overview. www.boeing.com/defense-space/space/spacestation/

Vergano, Dan. "NASA Releases Asteroid Capture Mission Details." http://www.usatoday.com/story/tech/sciencefair/2013/04/10/nasa-asteroid-capture/2071635/

Space: Where Are We Going?
Synthesis Unit
January 28-30, 2013

General Description and Instructions:

This year's Synthesis Unit will bring a variety of speakers to campus to talk about astronomy, space exploration and the future of space science. As you listen to the line up of speakers, you will begin to synthesize the information you hear and to understand this issue from experts in many fields related to space. You will earn a grade and academic credit for the Synthesis Unit, and it will appear on both your report card and your transcript. This grade will also be calculated into your GPA for the second semester.

The product for this year's Synthesis Unit is twofold: a research paper written individually and a group presentation. During the lectures, your task is to listen carefully to each speaker, take extensive, well-organized notes, as well as participate by being present, attentive, and asking questions occasionally. At the conclusion of the lectures, the team you are assigned to will meet and do research. In addition to contributing to the preparation of a formal presentation, you will be working individually to write a report on one facet of your group's topic.

Group Meeting Responsibilities:

- 1st meeting:
  - Team members will brainstorm topics for their individual written reports.
  - Appoint a technology coordinator, for digital copies of reports and any digital media used for the presentation.
- 2nd meeting:
  - Bring NOTES taken from two sources. These notes must be submitted with their sources cited in the correct format. (See "Formatting the Bibliography" handout.) Computer printouts do not count as notes.
  - The team will discuss possibilities for their group presentation to the school.
- 3rd meeting:
  - Bring the first draft of your report (double-spaced).
  - Teachers: Please keep a photo copy of each submission.
  - Presentation materials (posters, charts, diagrams) discussed.
- 4th meeting:
  - Turn in draft 2 of your report (double-spaced).
  - Plans for presentation are outlined by the team.
  - Each student's role in the presentation is determined.
  - Finished presentation materials submitted.
- 5th meeting:
  - Submit the final draft of your report to your group's teacher (single spaced).
  - Submit electronic copy to your group's technology coordinator.
  - Technology coordinator emails (or submits on thumb drive) copies of the group's reports to peggy@anacapaschool.org (We may try to use Google Docs, so we will clarify this later)
  - Rehearsal of the presentation.

All School Presentation

- Team makes a presentation at an all school assembly.

Space: Where Are We Going?
Synthesis Unit
January 28-30, 2013

These are your responsibilities throughout the Unit.

Pre-Synthesis Unit Test on *Survey Monkey* (10 Points)

During the three days of speakers and activities: 50 Points

- General participation in the Synthesis Unit presentations (25 points)
  - regular attendance, attentiveness, manners
  - You are required to ask a minimum of 1 question; to get full points, you will need to ask 3 questions.
- Note-taking during the presentations (25 points)
  - notes will be graded for quality and quantity

Throughout the group meetings: 50 Points

- Points are based on participation, productivity, and meeting deadlines
- Your group teacher may award "bonus points" to any member of the group who goes "above and beyond."

The product: 100 Points

- You will write a research paper that will be included in our Synthesis Booklet for the Unit. (You will receive detailed instructions for the report in your group meetings.)

The group presentation: 40 Points

- This is a group grade based on the presentation. Presentation guidelines are included in this packet

Bonus Points:

- Students will vote for the "best speaker," and that student will be awarded 20 bonus points.

The total possible points for the unit is 250. You will receive both a grade and unit credit on your 2nd semester report card. The grade will be calculated into your GPA.

If you have any questions about your responsibilities, you may ask Peggy or your group leader.

Space: Where Are We Going?
Synthesis Unit
January 28-30, 2013

How You Will Be Graded

Pre-Unit Survey
_____ 10 Points

Participation Criteria (50 Possible Points):

_____ 25 Points.	General participation in the Synthesis Unit presentations (regular attendance, attentiveness, manners, questions)
_____ 25 Points.	Note-taking during the presentations (notes will be graded for quality and quantity)

Group Meeting Deadlines, Participation, and Productivity (50 Possible Points):

_____ 10 Points.	Meeting 1
_____ 10 Points.	Meeting 2
_____ 10 Points.	Meeting 3
_____ 10 Points.	Meeting 4
_____ 10 Points.	Meeting 5

Written Report (100 Possible Points)
See "Guidelines for Writing the Report" handout.

Structure

_____ 5 Points.	Report is structured (Introduction, developmental paragraphs, conclusion).
_____ 5 Points.	Focus of report is clear, articulate, and organized so facts effectively support the focus.
_____ 5 Points.	Correct spelling and acceptable grammar.

Format

	Title (centered, 12 Point, Bold)
-.	Your name is at the end on bottom right. Your grade is below your name.
_____ 5 Points.	Margins: 1 Inch, Length: 1 page, single spaced, Font: 12 point only
_____ 10 Points.	Bibliography (See "Formatting the Bibliography")

Content:

_____ 10 Points.	Introduction
_____ 40 Points.	Quality and quantity of data
_____ 10 Points.	Conclusion

Completed Work Submitted

_____ 5 Points.	Hard copy of reported submitted on time
_____ 5 Points.	Electronic copy of report submitted on time

Group Presentation (40 Possible Points)

_____ 40 Points. See "Guidelines for Group Presentations" handout.

Bonus Points for "Best Speaker" (20 Possible Points) (as voted by the community):

Overall Synthesis Grade (250): Points _____ Percentage _____ Grade_____

Space: Where Are We Going?
Synthesis Unit
January 28-30, 2013

Guidelines for Writing the Report

Steps for Writing a Research Paper:

1. Begin gathering information and materials for your topic. The library and the internet are good places to start your search. Magazines may be good resources, too. Your notes from the Unit may also be useful.

2. Keep a list of your sources. You will need to include a bibliography of all the sources you used at the end of final paper. When you take notes, be sure to write the resource information down. (See instructions for the bibliography for the information you will need.)

3. Take notes. As you read about your topic, make notes in a designated note book so you can keep all your work together.
4.
5. Prepare an outline for your paper.

6. Begin organizing and writing your paper. You might structure your paper using chronological order, order of importance, or order of complexity. Create a solid introduction with a good thesis statement and finish off with a strong conclusion. Be careful to write the information in your own words and cite your references whenever you quote a source. (See "Citing Quotations" page)

7. After you get your 1st draft back from your teacher, make the appropriate adjustments and write another draft. Turn it in for further correcting.

8. Write your final draft, being careful to make it as perfect as possible. Be sure to proofread carefully several times. See "How You Will Be Graded" sheet for formatting requirements. Your paper will be published in our Synthesis Unit Booklet for the year. You must submit both a paper copy and an electronic copy.

9. Include your bibliography with your final draft in the required form.

Space: Where Are We Going?
Synthesis Unit
January 28-30, 2013

How to Format Citations and Bibliography

Citing Quotations:

When citing your resource within the text, put the author's last name and the page number in parenthesis directly after the quotation.

"Pigs in Space (Baker, p. 305).

Formatting the Bibliography:

Please use the following forms for your bibliography.

For an article on the internet:

Smith, Shayna. "Prehistoric UFO Landings on Earth." www.wearenotalone.edu

For information from notes taken during Synthesis Unit Lectures:

Name of speaker, date, title of lecture, Anacapa Synthesis Unit.

For a book:

Steiner, Ethan. *The Challenger Disaster*. Los Angeles: Putnam, 2007, p. 13-75.

For an encyclopedia:

"Space Colonies in 2500 A.D." *Encyclopedia Britannica.* 1991 ed. Vol. 2, p. 35-36.

For a magazine article:

Alexandre Dalbadie. "Hamster Habits on Space Flights." *National Geographic* October 1986, p. 53-64.

Your bibliography appears at the end of your paper. You should observe the proper formatting seen in the examples above. If you have a question, ask Peggy.

Space: Where Are We Going
Synthesis Unit
January 28-30, 2013

Presentation Guidelines

- The entire group will present together.
- Each member of the group will participate in the presentation.
- Presentations should be a minimum of 20 minutes to a maximum of 30 minutes long.
- Time should be left at the end of the presentation for questions. Time for questions must be within the 30 minute limit.
- There will be a time period between each presentation for the last group to remove any props and for the new group to set up.
- Each presentation should have at least one visual aid appropriate to the topic.
- Groups may use other props where appropriate, but the greatest part of the presentation should be information given orally by the participants.
- Presenters may use notes but are strongly discouraged from reading a prepared paper.

Grading of the Presentation

Evaluation of the presentations will be based on the following criteria.

- Effective introduction
- Organization of the elements of the presentation into an effective whole.
- Articulation of ideas
- Quality of the information presented
- Informative quality of the visual aids
- Smooth incorporation of props (if any)

- Extra props will not necessarily improve the grade
- Effective concluding remarks.

Anacapa School

FOUNDED IN 1981

2012-2013 SYNTHESIS UNIT

SPACE: WHERE ARE WE GOING?

MONDAY, JANUARY 28, 2013

8:00 a.m. Levi Maaia, Anacapa School Teacher and Synthesis Unit Coordinator
Space: Where Have We Been?

9:00 a.m. Matteo Cantiello, Ph.D., Research Fellow, Kavli Institute for Theoretical Physics, UCSB
Stars: Life, Death, and the Origin of Elements

10:00 a.m. Danica Marsden, Ph.D., Postdoctoral Researcher, Department of Physics and Astronomy, UCSB / Keck Institute for Space Studies, California Institute of Technology and Jet Propulsion Laboratory
Telescopes and the Universe

11:00 a.m. Philip Lubin, Ph.D., Professor, Department of Physics, UCSB
Origin, Evolution, and Fate of our Universe - Current Status

1:00 p.m. FILM: When We Left Earth
Episode 5: The Shuttle

2:00 p.m. Richard Linnehan, D.V.M., Astronaut, NASA
Life as an Astronaut

7:00 p.m. **PUBLIC PRESENTATION**, Faulkner Gallery, Santa Barbara Public Library
Richard Linnehan, D.V.M., Astronaut, NASA
The Future of Human Spaceflight

TUESDAY, JANUARY 29, 2013

8:00 a.m. Kristy Johnson, Astronomy Instructor, Department of Earth and Planetary Sciences, SBCC
Ancient Astronomy: The Intersection of Heaven and Earth

9:00 a.m. Michael Johnson, Graduate Student, Department of Physics, UCSB
Pulsars and the Search for Little Green Men

10:00 a.m. Nathan Walker, Design Engineer, ATK Space
How to Power Your Spaceship

11:00 a.m. **FIELD TRIP**: Vandenberg Air Force Base
Larry Hill, Chief, Community Relations, 30th Space Wing, Vandenberg Air Force Base

WEDNESDAY, JANUARY 30, 2013

8:00 a.m. Jack Stuster, Ph.D., Principal Scientist, Anacapa Sciences
Getting Along in Space: Results of the Journals Flight Experiment

9:00 a.m. Members of the Anacapa Near Space Exploration Club (ANSEC)
Contacting the International Space Station (ISS) with Ham Radio

10:00 a.m. Michael McGee, Super Surveyor, McGee Surveying Consulting
Mapping the Earth from Space

11:00 a.m. Derek Dunn-Rankin, Ph.D., Professor and Chair, Department of Mechanical and Aerospace Engineering, University of California, Irvine
Flames in Space: Microgravity Combustion Science

1:00 p.m. Warren Rogers, Ph.D., Professor, Physics Department, Westmont College
Creation of the Elements in Stars

2:00 p.m. Eric Belle, Systems Engineer, Raytheon Company / International Council on Systems Engineering
Space-Based Remote Sensing Systems

7:00 p.m. **STARGAZING PARTY!** on Anacapa School Campus
Chuck McPartlin, Outreach Officer, Santa Barbara Astronomical Unit

NASA photo

Anacapa School
FOUNDED IN 1981

RICHARD M. LINNEHAN (BS, DVM, MPA)
NASA ASTRONAUT

NASA Biography:

PERSONAL DATA: Born September 19, 1957, in Lowell, Massachusetts. Raised by his paternal grandparents, Henry and Mae Linnehan. He enjoys various sports, outdoor activities and natural history. His sister, Colleen, resides in Nevada.

EDUCATION: Attended Alvirne High School, Hudson, New Hampshire from 1971-1974. Graduated from Pelham High School, Pelham, New Hampshire, in 1975. Attended the University of New Hampshire in Durham, New Hampshire graduating in 1980 with a Bachelor of Science degree in Animal Sciences with a minor in Microbiology. Received the degree of Doctor of Veterinary Medicine (D.V.M.) from The Ohio State University College of Veterinary Medicine in 1985. Honorary Doctorates of Science from the University of New Hampshire (2002), Suffolk University (2002) and Ball State University (2009). In 2009 received the degree of Master of Public Administration (MPA) from The Kennedy School of Government at Harvard University.

ORGANIZATIONS: Member of the American Veterinary Medical Association, the American Association of Zoo Veterinarians, the International Association of Aquatic Animal Medicine, the Association of Space Explorers, and the Explorers Club. Adjunct Professorships at the North Carolina State University College of Veterinary Medicine, Raleigh-Durham, North Carolina and the Texas A&M University College of Education, College Station, Texas. Board member, Channel Islands Marine and Wildlife Institute (CIMWI), Santa Barbara, CA.

SPECIAL HONORS: Navy Group Achievement Award, Navy Commendation Medal, four NASA Space Flight Medals (1996, 1998, 2002, 2008), NASA Outstanding Leadership Medal (1999), NASA Exceptional Service Medal (2002), NASA Distinguished Service Medal (2009), AVMA President's Award, The OSU College of Veterinary Medicine Alumni Award, and The University of New Hampshire Distinguished and Outstanding Alumni Awards.

EXPERIENCE: After graduating from The Ohio State University College of Veterinary Medicine in June 1985, Dr. Linnehan entered private veterinary practice and was later accepted to a 2-year joint internship in zoo animal medicine and comparative pathology at the Baltimore Zoo and The Johns Hopkins University. After completing his internship Dr. Linnehan was commissioned as a Captain in the U.S. Army Veterinary Corps and reported for duty in early 1989 at the Naval Ocean Systems Center, San Diego, California, as chief clinical veterinarian for the U.S. Navy's Marine Mammal Program. During his assignment at the Naval Ocean Systems Center Dr. Linnehan initiated and supervised research in the areas of cetacean and pinniped anesthesia, orthopedics, drug pharmacokinetics and reproduction in direct support of U.S. Navy mobile marine mammal systems stationed in California, Florida, and Hawaii.

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NASA EXPERIENCE: Selected by NASA in March 1992, Dr. Linnehan reported to the Johnson Space Center (JSC) in August 1992 where he completed one year of Astronaut Candidate training qualifying him for Space Shuttle flight assignments as a Mission Specialist. Dr. Linnehan was initially assigned to flight software verification in the Shuttle Avionics Integration Laboratory (SAIL). He was subsequently assigned to the Astronaut Office Mission Development Branch, working on payload development and mission development flight support for future Space Shuttle missions. He first flew as a mission specialist in 1996 on STS-78, the Life Sciences and Microgravity Spacelab (LMS) mission. In 1998, he served as the payload commander on the STS-90 Neurolab mission. In 2002, he was a member of the 4-man EVA crew on STS-109, the fourth servicing mission to the Hubble Space Telescope. In 2008, he was lead EVA crewmember on the STS-123/1JA mission to the International Space Station. A veteran of four space flights, Dr. Linnehan has logged over 58 days in space, including 6 Extra Vehicular Activities (EVAs or "spacewalks") totaling 42 hours and 11 minutes. In August 2009 Linnehan returned to Houston, TX and the Astronaut Office after completing a Master's degree in Public Administration at the Harvard Kennedy School of Government in Boston, MA. Presently, Dr. Linnehan is assigned to The Office of Strategic Initiatives at the Texas A&M University, College Station, TX on a NASA Interagency Personnel Agreement (IPA) targeting collaborative research projects and Science, Technology, Engineering and Mathematics (STEM) educational initiatives in direct support of JSC/NASA and the Texas A&M University System.

SPACEFLIGHT EXPERIENCE: STS-78/LMS (June 20 to July 7, 1996). The Life Sciences and Microgravity Spacelab mission was flown aboard Space Shuttle Columbia. The 17-day flight included studies sponsored by ten nations and five space agencies, and was the first mission to combine both a full microgravity studies agenda and a comprehensive life sciences payload. STS-78 orbited the Earth 271 times, covered 7 million miles in 405 hours and 48 minutes and was the longest duration Space Shuttle mission to date.

STS-90/Neurolab (April 17 to May 3, 1998) was Dr. Linnehan's second Spacelab mission. During the 16-day flight the seven-person crew aboard Space Shuttle Columbia served as both experimental subjects and operators for 26 individual life science experiments focusing on the effects of microgravity on the central and peripheral nervous systems. STS-90 orbited the Earth 256 times, and covered 6.3 million miles in 381 hours and 50 minutes. Both the LMS and Neurolab missions served as models for future life sciences studies to be conducted on board the International Space Station (ISS).

STS-109/HST Servicing Mission 3B (March 1-12, 2002) was the fourth Hubble Space Telescope (HST) servicing mission and Dr. Linnehan's third flight aboard Columbia. The crew of STS-109 successfully upgraded the Hubble Space Telescope's systems over the course of 5 consecutive EVAs, leaving it with a new power control unit, improved solar arrays, the new Advanced Camera for Surveys (ACS), and an experimental refrigeration unit for cooling the dormant Near Infrared Camera and Multi-Object Spectrometer (NICMOS). With his teammate Dr. John Grunsfeld (EV1), Dr. Linnehan (EV2) performed three of the five spacewalks totaling 21 hours and 9 minutes. STS-109 orbited the Earth 165 times and covered 3.9 million miles in just over 262 hours.

STS-123/1JA (March 11-26, 2008) aboard Space Shuttle Endeavour was a night launch and landing and the 25th Shuttle/ISS assembly mission. Endeavour's crew delivered the Japanese Experiment Logistics Module – Pressurized Section (JEM), the first component of JAXA's "KIBO" Laboratory, and also the final element of the station's Mobile Servicing System, the Canadian-built robot, "DEXTRE", also known as the Special Purpose Dexterous Manipulator (SPDM). As lead space walker, Linnehan (EV1) performed three of five total spacewalks during the mission, logging 22 hours and 02 minutes of EVA time and served as IV1 for the remaining two EVAs. The STS-123 crew also delivered Expedition 16 Flight Engineer Garrett Reisman (EV4), and returned to Earth with the European Space Agency's (ESA) Léopold Eyharts. The mission was accomplished in 250 orbits of the Earth, traveling over 6 million miles in 15 days, 18 hours, 10 minutes and 54 seconds.