Investigation Activities

for

Apollo 13

Science in Space & Learn About Apollo 13

ROCKADEMIX™

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Apollo 13 – *Science in Space* & *Learn About Apollo 13* – Song & Graphic Novel

Investigation Activities

The Apollo 13 Investigation Activities are divided into three levels, easy, medium or advanced academic level. You are welcome to use all three levels or choose a level that best matches the academic level of your students.

Apollo 13 – *Learn About Apollo 13* – Graphic Novel

Name _____ Date _____

How are Astronauts Protected in Space? #1

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5, Engineering Design gr. 5)

Astronauts travel in space. They wear spacesuits. The spacesuits are white to keep the sun's heat away. Space can be cold. The spacesuits can keep the astronauts warm.

There is air in their backpacks to breathe. There is water to drink. A rocket added to their backpacks helps them to fly around in space. They can leave the spaceship. A camera takes pictures of what the astronaut is doing.

The spacesuits help to keep the astronauts safe.

aviationweek.com

1. Name 2 things a spacesuit does.

2. Name 3 things that an astronaut's backpack carries.

3. How do other people know what an astronaut is doing in space?

Name _____ Date _____

How are Astronauts Protected in Space? #2

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5, Engineering Design gr. 5)

Astronauts need to be protected in space. Space can be very cold if the sun is not shining and very hot when it is shining. So astronauts need a suit to protect them from the cold and heat when they go out in space to do an experiment or to fix a satellite.

science.howstuffworks.com

The spacesuits have a large backpack that carries oxygen for the astronauts to breathe. The backpacks have water to drink. There is a place to get rid of body waste. Spacesuits are full of air to support the astronauts' bodies. That is why the suits look puffed up.

Some suits have rocket-powered backpacks so the astronaut can fly around in space and not be connected to the spacecraft. Sometimes a camera is attached above the astronaut's head so the other crew members and scientists on Earth can tell what the astronaut is seeing.

1. How can space be both cold and hot?

2. Name 3 things that are in spacesuit's backpack.

3. What is the purpose of a rocket-powered backpack?

4. Why might an astronaut have a camera?

Name _____ Date _____

How are Astronauts Protected in Space? #3

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5, Engineering Design gr. 5)

Astronauts must wear a specially designed spacesuit which maintains a constant pressure around their bodies when they go out in space to do experiments or to fix a satellite. There are over a dozen layers of material that protect the astronaut from the sun's rays and the tiny particles of space dust that travel at high speeds through space. There is a special visor that protects the astronaut's eyes from the harmful solar radiation. The layers of the suit are white to reflect the sun's light. An absorption garment to absorb waste products is worn.

The spacesuit provides a life-support system in the astronaut's backpack so the astronaut can survive in space for short periods of time. It includes oxygen to breathe and water to drink. The suit is also built to remove the dangerous carbon dioxide that the astronauts exhale.

Moving around in space quickly is difficult as the spacesuit is bulky. The Manned Maneuvering Unit is designed to help the astronaut move through space. It is like an armchair with small thrusters for the astronauts to adjust their position very slightly or to move more quickly through space. The unit is operated by a hand control much like one used in playing video games.

1. Explain at least 3 features of the spacesuit that protect the astronaut from the sun.

2. Why was the life-support system added to the astronaut's backpack?

3. What evidence in the text suggests the purpose of the Manned Maneuvering Unit?

Name _____ Date _____

How Do Rockets Get Into Space? #1

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5+)

Did you ever let the air out of a balloon? That is how a rocket works. The air goes one way. The balloon moves in a different way. In a rocket, the gases at the bottom of the rocket push the rocket up.

Rockets are very heavy. Most of the weight is fuel. Rockets need the fuel to move out of Earth's gravity. They must go very fast to orbit into space. So a lot of fuel is used up when a rocket takes off.

Most rockets have 2 or 3 parts. When a part uses up its fuel, it falls off. Then it lands in the ocean or burns up in space. After the rocket loses a part, it becomes lighter. Then it can move faster and easier in space.

en.wikipedia.org

1. How is a rocket like a balloon when you let out the air?

2. Name one thing that makes a rocket very heavy.

3. How does a rocket get lighter in space?

Name _____ Date _____

How Do Rockets Get Into Space? #2

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

In order to escape Earth's strong gravitational pull, a rocket has to reach a speed of about 25,000 miles per hour. After the rocket is in orbit, its power is shut off. Rockets burn liquid hydrogen and oxygen. In fact, at takeoff, a rocket burns more than 600,000 gallons of fuel in 3 seconds. That is about as much fuel to fill an Olympic-size swimming pool! For every pound of rocket fuel burned, a pound of exhaust gas is let out of the base of the rocket. This downward gas fires the rocket upward.

www.bhmpics.com

Now you know why rockets have to carry a huge amount of fuel to make the journey into space and back. Most rockets are made up of sections to store the liquid hydrogen and oxygen. Each section has its own engines, fuel, and oxygen tanks. When the fuel is used up in one section, then this part of the rocket is let go. Scientists use the word "jettisoned" to describe this process. This helps the rocket to weigh less and to move more easily. Usually, these parts drop into the ocean, where they are recovered and reused for another launch. Sometimes, the parts burn up in space.

1. Why do rockets burn so much fuel at the takeoff?

2. According to the text, what 3 things are in each section of the rocket?

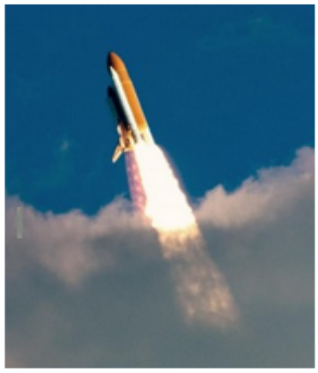
3. Why do you think a section of the rocket is let go after the fuel is used up in that section?

Name _____ Date _____

How Do Rockets Get Into Space? #3

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

Just like airplanes, space rockets work on a principle called action and reaction. This is another name for Newton's third law of motion. When the hot gases fire backwards from a rocket's engine, this produces an equal force that pushes the rocket forward. In the first few minutes of a mission, most of the fuel on-board a rocket is used so the rocket reaches at last 25,000 miles per hour to escape Earth's gravity.



space.stackexchange.com

Air pressure plays a crucial role while the rocket is still in the atmosphere. The internal pressure inside the rocket engine has to be greater than the outside pressure that escapes. When the rocket climbs into space, the pressure becomes less and less, the atmosphere thins, and the engine thrust increases.

Something else to consider in rocket propulsion is the changing mass of the rocket. As more gases are burned, the total mass of the spaceship decreases. Therefore, there is less resistance to change in motion. This results in an increase in upward acceleration of the rocket.

All of these factors help to get rockets into space.

1. Explain how the principle of action and reaction helps propel a rocket into space. Use your own words.

2. Why do you think the author mentioned in the text that a rocket must reach 25,000 miles per hour to escape Earth's gravity?

3. Besides Newton's law of gravity, explain two other factors that play a role in getting the rocket into space.

Name _____ Date _____

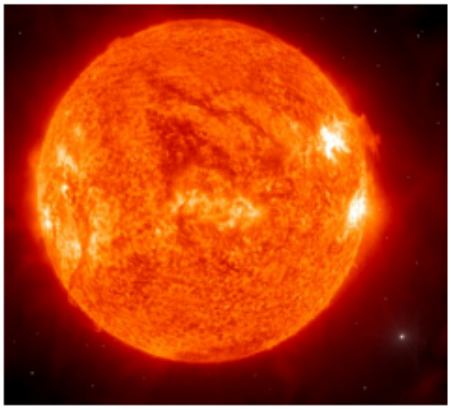
How Hot is the Sun? #1

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

The sun is a hot, large ball in the sky. The sun is a star. It is at the center of the solar system. The sun looks big because it is closer to Earth than other stars in the sky. You see the sun in the daytime. The sun's light hides the other stars. At night, there is no light from the sun. Then we can see other stars.

The sun is made of burning gas. It is so hot that it is a hundred thousand times hotter than a kitchen oven! The middle part of the sun is the hottest part. This is where hot gases rise. You should never look at the sun with your eyes. It might harm them.

The sun gives off energy. It makes light that shines on Earth. The sun makes heat, too. It warms the land and water. It warms the air. The sun helps plants make food for us to eat and oxygen for us to breathe.



wonderopolis.org

1. Name 3 facts about the sun.

2. Why does the sun look so big?

3. Why can't you see other stars in the daytime?

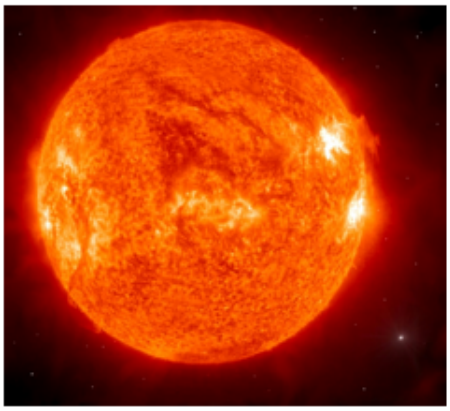
4. Name 2 things that the sun makes to help living things on Earth.

Name _____ Date _____

How Hot is the Sun? #2

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

The sun is a large ball of gas. In fact, it is so large that if it were hollow, one million Earth-sized planets could fit inside of it! The sun sends out light in all directions. It provides the right amount of sunlight so we can have life on Earth.



wonderopolis.org

The sun's surface, called the photosphere, is about 10,000 ^{o}F. Above this is a hotter part of the atmosphere. The temperature can get as hot as 27,000 ^{o}F. If you think that's hot, the temperature in the center of the sun, called the core, can get hotter than 27 million ^{o}F! The core is so hot that it makes energy that travels out from the sun in the form of gamma rays. The sun's yellow color is caused by its high temperatures.

The sun is very dangerous to look at with your eyes, binoculars, or even through a regular telescope. When scientists look at the sun, they use special telescopes with mirrors to reflect the light. These are called tower telescopes.

1. What does the text say about the size of the sun and Earth?

2. What part of the sun is the hottest?

3. Explain how gamma rays are made.

4. What do people use to look at the sun?

Name _____ Date _____

How Hot is the Sun? #3

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

The sun is a huge ball of searing hot hydrogen and helium gas, kept ablaze by nuclear reactions deep in its core. These nuclear reactions produce tremendous quantities of heat and light, which are released gradually over billions of years. The temperature at the surface of the sun is almost 10,000 ^{o}F, but deep in the middle core the temperatures are over 25 million ^{o}F. Here, hydrogen atoms join helium atoms to give off huge amounts of energy. This process is called nuclear fusion. There are currents that rise and fall in the outer layers that carry the heat outward from the core. These currents are moving faster than 2,000 miles per hour. The heat and light that come outward from the sun help the plants and animals to live. Scientists study the sun with long-range instruments based on Earth. They also use orbiting space stations and special space probes to get a closer look. Looking directly at the sun may cause serious harm to your eyes.

topwalls.net

1. How are the sun's heat and light produced?

2. How is the heat from the sun's core moved outward?

3. Why are the sun's heat and light necessary for Earth?

4. Why do you think scientists study the sun with long-range instruments?

Name _____ Date _____

What Do Satellites Do? #1

Next Generation Science Standards (Engineering, Technology, and Applications of Science gr. 5)

The Moon and Earth are satellites. The Moon orbits the Earth. The Earth orbits the Sun. But satellites can be made by man, too. They are sent into space to orbit. Their job is to send, receive, or bounce back information to different parts of Earth. Satellites are sent on rockets into space. Thousands of satellites have been sent into space. About half of these are in orbit. The others are left in space, but they are not used.

www.spacetoday.org

There are many kinds of satellites:

- Communications - relay television, radio, telephone, and Internet signals
- Astronomical - study space
- Earth observation - tell what the weather will be like
- Navigational - give information for GPS's (global positioning systems)
- Military – observe troop movements

1. Why are the Moon and the Earth satellites?

2. Why are the satellites that are made by man sent into space?

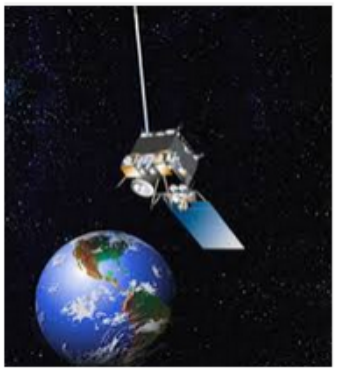
3. Why do you think communications satellites are important?

Name _____ Date _____

What Do Satellites Do? #2

Next Generation Science Standards (Engineering, Technology, and Applications of Science gr. 5)

The Moon and Earth are natural satellites. The Moon orbits the Earth and the Earth orbits the Sun. But satellites can be man-made, too. They are sent into space to reach their orbits. Their job is to send, receive, or bounce back information to different areas of the Earth. These satellites have an antenna to send and receive information and a power source such as a solar panel or battery. They need to travel at a speed faster than 17,500 mph to stay in orbit.



www.ospo.noaa.gov

Satellites are launched on rockets into space. Thousands of satellites have been sent into space, and about half of these are in orbit today. Many of the satellites that are no longer used remain in space as debris. To keep the satellites from flying out of control, some are designed to spin to remain stable. This is similar to a toy top spinning.

There are different kinds of satellites that are very helpful to modern life:

- Communications – relay television, radio, telephone, and Internet signals
- Astronomical – observe space
- Earth observation – predict the weather, collect data about the environment, and create maps
- Navigational – provide data for global navigational systems
- Military – observe troop movements and gather intelligence

1. What is the difference between a natural and a man-made satellite?

2. Explain at least 3 common characteristics of man-made satellites.

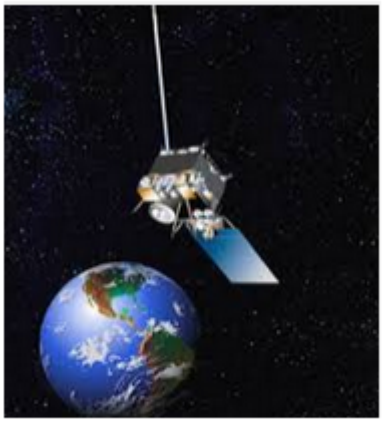
3. Summarize in your own words the 5 different kinds of satellites and their purposes.

Name _____ Date _____

What Do Satellites Do? #3

Next Generation Science Standards (Engineering, Technology, and Applications of Science gr. 5)

Any object in orbit around a celestial body is called a satellite. The Moon orbiting the Earth and the Earth orbiting the Sun are natural satellites. Since 1957, thousands of artificial satellites have been launched into orbit around Earth. They transmit radio signals to locations across the planet. The satellites are equipped with an antenna to send and receive the information and a power source such as a solar panel or battery. They travel at speeds faster than 17,500 mph to stay in orbit.



www.ospo.noaa.gov

Satellites are launched on rockets with enough speed to prevent the Earth's gravity from pulling it back down to the ground. To keep the satellites from flying out of control, some are deliberately designed to spin. They have small, spinning wheels at various points on their frames. These realign the satellite if it moves off course.

Satellites are vital to modern life and used in many areas of technology, including communications, entertainment, and espionage. Following are some common types and their uses:

- Communications – relay television, radio, telephone, and Internet signals
- Astronomical – observe space
- Earth observation – predict the weather, collect environmental data, and create maps
- Navigational – provide data for global navigational systems
- Military – observe troop movements and gather intelligence; provide military communication and navigation

1. What do the artificial satellites require to transmit radio signals to locations across the planet?

2. Why is speed a factor for satellites being launched and staying in orbit?

3. Summarize in your own words the 5 different kinds of satellites and their purposes.

Name _____ Date _____

What Do We Know About the Moon? #1

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

Have you ever looked up at the night sky to see the moon? The moon looks bigger than the stars in the sky. That is because the moon is closer to Earth than the stars. But the moon is smaller than many stars and planets. Earth is four times larger than the moon.

www.rocketcityspacepioneers.com

The moon is always moving. It moves around Earth. It takes about one month to go around Earth. The moon spins as it moves around Earth. That is why we always see the same side of the moon.

The moon is quiet. No plants or animals live there. People can't live on the moon because there is no oxygen to breathe. There is no rain, snow, or wind. The sky is always dark. Gray rocks and dust cover the moon. The moon's surface is flat. Other parts have high mountains or deep valleys. There are craters that look like large bowl shapes in the ground. The largest crater is half as wide as the United States. Without an atmosphere to keep the moon from the Sun's heat, it gets very hot in the day. At night there is no atmosphere to keep in the heat, so it gets very cold.

1. How much larger is the Earth than the moon?

2. Why do we see the same side of the moon?

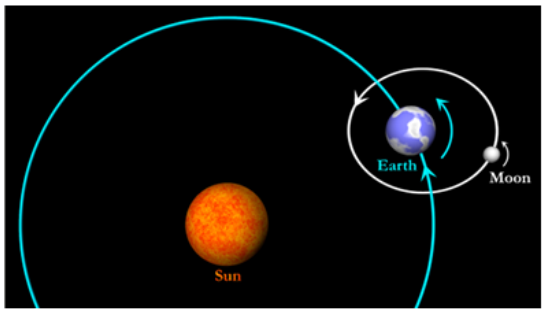
3. List 5 things you learned about the moon.

Name _____ Date _____

What Do We Know About the Moon? #2

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

The moon is a round object that moves around Earth. It does not make light. We can see the moon because the sun shines on it. The moon looks like it changes in size. That is because we only see the part of the moon that the sun shines on. These different shapes are called phases of the moon. The side of the moon that we see from Earth is called the near side. A full moon is when you can see the whole side of the moon.



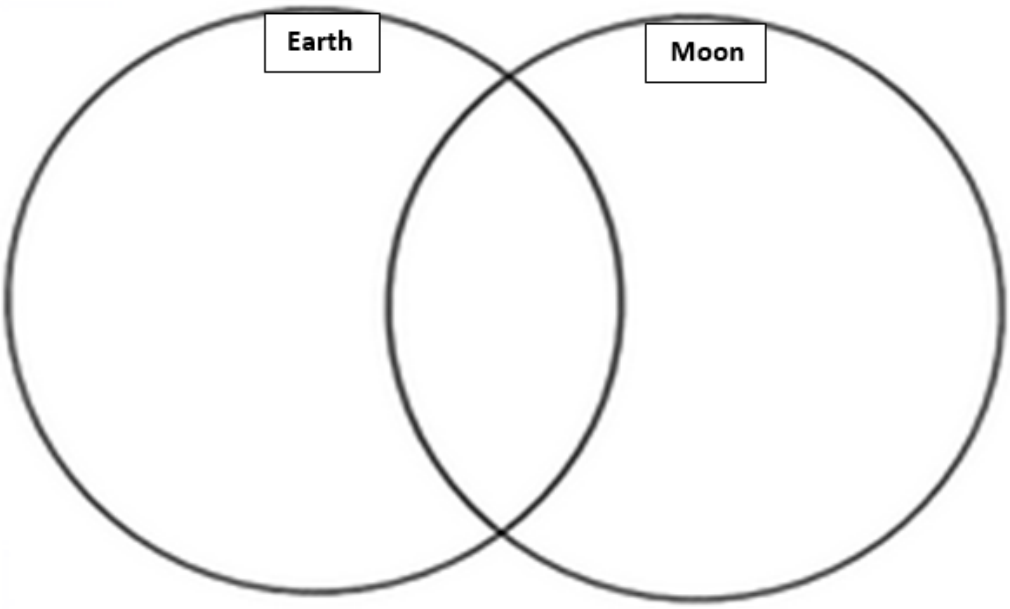
http://moonblink.info/Eclipse/why/solsys

The moon is about one hundred times closer to us than the nearest planet, Venus. It travels around Earth once each month. Earth is about four times larger than the moon. The moon is made up of rock, just like Earth.

But the moon does not have air, water, plants or animals. There is no sound on the moon either. The dark parts of the moon are flat plains. The lighter parts are the highlands and mountains. Earth and moon are the same distance from the sun and get the same amount of heat from the sun. But because there are no gases in the atmosphere to help filter the sun, the temperatures on the moon in the day are hotter than on Earth. The temperatures are hotter than the boiling point of water (212 ^{o}F). At night the temperatures on the moon are colder than the temperature on Earth (-280 ^{o}F). This is because there are no clouds to stop the heat from escaping at night. If you are standing on the moon, the sky would look always look black. Again, this is because there is no atmosphere. There is nothing that helps scatter the sunlight.

Compare and contrast.
Use these words:

orbits Earth
orbits sun
4 times larger
made of rock
no air or water
air and water
no plants and animals
plants and animals
no sound
sound
same distance from sun
very hot
very cold
sunlight



Name _____ Date _____

What Do We Know About the Moon? #3

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

The moon is about 100 times closer to Earth than the nearest planet, Venus. It is the Earth's only natural satellite and travels around Earth once a month. The moon is quite small, about a quarter of Earth's diameter; and because of its size, the force of attraction is too weak to hold the gases it would need to form an atmosphere. So without a layer of air, the Moon can't trap the Sun's heat to warm it at night or protect itself from the heat during the day.

hikeandsurvive.com

Different amounts of the moon's surface are lit by sunlight as it orbits Earth. This creates the various phases of the moon. These phases follow a cycle from a new moon where the dark side is facing us and the moon appears invisible to a full moon, where the entire sunlit part is visible.

www.spacewallpapers.net

The eastern half of the side of the moon that faces Earth is made up of craters, rugged mountains, walled plains, and circular seas. The western half of the side of the moon that faces Earth is mostly covered by vast seas. Did you know that there has never been water on the moon? The term "sea" is used to represent the area on the moon that appears to look like the course of a river or large sea.

The far side of the moon, the side of the moon that we do not see, remained a mystery to astronomers until 1959. That's when the Russian Luna 3 space probe traveled behind the moon and sent back photographs.

1. Explain the phrase "Earth's only natural satellite" as it is referenced in the text.

2. Explain how having no atmosphere impacts the temperature on the moon during the day and night.

3. What causes the phases of the moon?

4. Describe the 4 surfaces of the moon.

5. Why were the photographs from the Russian Luna 3 space probe significant?

Name _____ Date _____

What Has Space Technology Taught Us? #1

Next Generation Science Standards (Engineering, Technology, and Application of Science – Optimizing the Design Solution gr. 5)

Scientists have made many things to be used in space. Some of these things have been changed so people can use them on Earth. Digital watches and clocks are two of these things. The glass on watches and clocks is strong. It will not break easily with the force of gravity.

Lightweight clothing is made with some of the same materials that space clothing is made out of. Microchips found in computers and cell phones were made to fit small spacecraft. Food packed without air in tin cans and tin foil were made to be used in space. Solar power, ski goggles that don't fog up, power tools and vacuum cleaners without cords, and a joystick for playing video games were all first used in space.

It is interesting to see how some things made to be used in space can be changed to be used on Earth.

1. Many things that ere made to be used in space are used on Earth. Name 5 of these things talked about in the text.

2. Fill in the blanks with words from the text.

Scientists have _____ many _____ to be used in

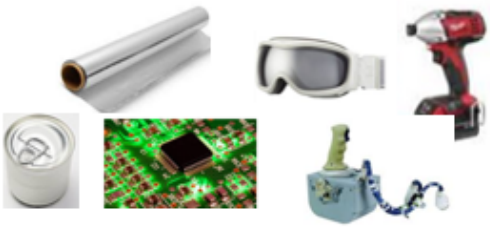
_____. Some of these things have been _____ so

_____ can use them on _____.

Name _____ Date _____

What Has Space Technology Taught Us? #2

Next Generation Science Standards (Engineering, Technology, and Application of Science – Optimizing the Design Solution gr. 5)



Research in space has been used to help us in everyday life. There have been thousands of ideas taken from space and adapted for human beings' life on Earth. Microchips found in digital watches, computers, and cell phones were first made so that lots of equipment could fit into a small spacecraft. Many household items have come from space technology including airtight cans and tin foil. Technologies such as solar power and keyhole surgery have also improved because of the space program. Car-controlled systems used by one-handed drivers came from the one-handed technique used in the lunar rover. Advanced smoke detection systems use technology that was developed for smoke detection on some of the space stations. Protective clothing designed for astronauts is used on ski slopes. There are electrically heated goggles that keep moisture from condensing on the inside of the goggles. The idea behind cordless power tools and vacuum cleaners came from drilling for moon samples. The joystick for video games was first used on a lunar rover. It is interesting to see the impact of space and technology on everyday life.

1. Why do scientists use many of the ideas from space research and adapt them to human beings' life on Earth?

2. What character traits do you think space industry researchers need to have to be successful in their careers?

Name _____ Date _____

What Has Space Technology Taught Us? #3

Next Generation Science Standards (Engineering, Technology, and Application of Science – Optimizing the Design Solution gr. 5)

Space industry research has been used to benefit our everyday lives on Earth. Thousands of technologies and techniques designed for space have been transferred to or adapted for human beings' life on Earth, often in areas totally unrelated to the research. Many of these ideas are used in medicine.

An insulin pump invented for diabetes is based on technology used by a spacecraft that landed on the planet Mars. Artificial limbs with controls to pick up very small objects as well as miniature devices as tiny as a pinhead that are placed in a human's heart to monitor its rhythm were developed from space technology. An MRI scan to give a clear overall view of what is happening in the human body was adapted from the image-enhancement technique devised to improve the sharpness of Moon photography. Reflective blankets used to retain a patients' heat, special beds for burn patients, and small television cameras worn on a surgeon's head to let others watch and learn from the operation are all developed from space technology.

Other everyday items like airtight cans and tin foil, microchips found in computers and cell phones, digital watches and clocks, and cordless power tools and vacuum cleaners all have been influenced by space industry research. Technologies such as solar power, car-controlled systems used by one-handed drivers, advanced smoke detection systems, electrically heated ski goggles to the goggles don't retain moisture, and joysticks used in video games are all ideas that have been adapted from items originally designed for space exploration.

1. Why do you think scientists use many of the ideas from space research and adapt them to human beings' life on Earth?

2. What character traits do space industry researchers most likely need to have to be successful in their careers?

3. What are some reasons that many of the technologies and techniques designed for space, and then transferred to or adapted for human beings' life on Earth, are used in medicine?

Name _____ Date _____

What is a Space Probe? #1

Next Generation Science Standards (Science and Engineering Practices – Influence of Science, Engineering, and Technology on Society and the Natural World gr. 5)

Space probes are large crafts that are robotic. They are sent into space. People do not live on them. Most of the probes stay in space. They do not come back to Earth. The probes do experiments. They take pictures of our solar system. Scientists can learn from the pictures. They learn about weather. They learn about the planets.

www.worldbulletin.net

Some probes fly by the planets from far away. Others go close by. There are probes that can land on the planets. They are called landers. These probes study the soil. They study how the land on the planet is formed.

The probes send the pictures and information back to scientists on Earth. This helps the scientists to plan for space trips.

1. What do space probes do?

2. How is a lander different from a flying space probe?

3. Why are space probes helpful?

Name _____ Date _____

What is a Space Probe? #2

Next Generation Science Standards (Science and Engineering Practices – Influence of Science, Engineering, and Technology on Society and the Natural World gr. 5)

Space probes are large, robotic craft that are sent into space. They are made to conduct experiments. They don't have people on them. Space probes get information about our solar system. The information gathered helps the scientists to better understand the weather and other changes happening on planets other than the Earth. This is useful to plan future space missions.

phys.org

Space probes have different jobs. Some fly and take pictures of the planets' surfaces and atmospheres. Others enter a planet's orbit to look at the planet in more detail. The third kind are landers. Landers are probes that touch down on the planet's surface. They travel short distances and study the soil and how the land is formed.

Most probes get their power from electricity. They use solar panels to change the sun's rays into electricity. Other probes use a chemical gas.

1. What do scientists learn from the information gathered by probes?

2. Why are space probes helpful to future space missions?

3. Describe the 3 different kinds of probes and their purposes that are mentioned in the text.

Name _____ Date _____

What is a Space Probe? #3

Next Generation Science Standards (Science and Engineering Practices – Influence of Science, Engineering, and Technology on Society and the Natural World gr. 5)

pixshark.com

Space probes are highly advanced robotic craft, often the size of a large car. They are launched into space to investigate celestial objects. Their use of sensitive equipment on board helps them to communicate with mission specialists on Earth. Images are transmitted as radio signals that are received by radio telescopes back on Earth. Space probes have varied jobs: some travel quickly by the planets and take pictures while others enter the planet's orbit to get a closer look at the planet. The probes that provide the most information are called landers, as they actually land on the surface of the planet. They study the soil composition and land formations of the planet. Most probes are powered by electricity generated by the attached solar panels; some use a nuclear generator. A more modern method is the ion drive which uses reactions in a chemical gas. Space probes are beneficial to scientists as they help them to learn more about our universe. This in turn helps with the preparation of future space explorations.

1. Explain how space probes communicate with mission specialists on Earth.

2. Compare and contrast the different types of space probes.

3. How do space probes help with preparation of future space explorations?

Name _____ Date _____

What is a Spider-Bot? #1

Next Generation Science Standards (Engineering, Technology, and Applications of Science gr. 5)

At NASA (National Aeronautics and Space Administration) in California, scientists have invented spider-bots. Spider-bots are tiny robots that can crawl into very small places. Yosi was the first spider-bot that was made. It had six legs. Yosi was 7 inches tall and weighed less than 1 pound. It had a camera for eyes and two long feelers. A little computer brain helped move its legs. A person used a remote to help Yosi choose which way to go.

www-robotics.jpl.nasa.gov

The idea of the spider-bot came from a real spider. There are other spider-bots. Some have six, eight, or even eighty legs. Scientists want the legs to be replaced with tools. The tools would dig, repair, and do experiments while exploring objects in space.

Today the spider-bots use batteries that need to be replaced. In the future scientists want to make skin for the robots so it can get energy from the Sun. Then it would not run out of power. The spider-bot could be used on long trips in space.

1. Where did scientists get the idea of a spider-bot?

2. Explain why the spider-bot is helpful to scientists.

3. Why are spider-bots useful in studying space?

Name _____ Date _____

What is a Spider-Bot? #2

Next Generation Science Standards (Engineering, Technology, and Applications of Science gr. 5)

At NASA (National Aeronautics and Space Administration) in California, scientists have invented spider-bots at their lab. Spider-bots are tiny robots that can crawl into very small places. They were designed to do repairs on space stations. Yosi was the first spider-bot made even though it had only six legs. It was 7 inches tall and weighed less than one pound. Yosi had a camera for eyes, two long feelers that sensed obstacles nearby, and a small computer brain to help move its legs. A person used a remote to help Yosi choose which way to go.

www-robotics.jpl.nasa.gov

The idea of the spider-bot came from observing a real spider. There are other spider-bots; some have six, eight, or even eighty legs. Scientists want the legs to be replaced with tools to dig, repair, and conduct experiments while exploring objects in space.

Today the spider-bots use batteries that need to be replaced. In the future scientists plan to design skin for the spider-bots so they can absorb energy from the Sun and never run out of power. They also want to keep improving the robots so they are tougher, faster, smaller, and smarter. Then the spider-bots could be used on longer missions in space.

1. How is the spider-bot similar to a spider?

2. Why do scientists keep improving the spider-bots?

3. Why are spider-bots useful in studying space?

Name _____ Date _____

What is a Spider-Bot? #3

Next Generation Science Standards (Engineering, Technology, and Applications of Science gr. 5)

At the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory in California, scientists have invented spider-bots. Spider-bots are tiny robots that can crawl into very tight places on space stations to do repairs. Yosi was the first spider-bot made even though it had only six jointed legs. It was 7 inches tall and weighed less than one pound. Yosi had a camera for eyes, two long feelers that sensed obstacles nearby, and a small computer brain to help move its legs. A person used a remote to help Yosi choose its path.

www-robotics.jpl.nasa.gov

The idea of the spider-bot was inspired by observing a real spider. There are other spider-bots; some have six, eight, or even eighty legs. Scientists want the legs to be irreplaceable with tools to dig, repair, and conduct experiments as the robots help to explore objects in space. Spider-bots are inexpensive to build; the construction cost for one is approximately $600.00.

Today the spider-bots use batteries that need to be replaced. In the future scientists plan to design artificial skin that can absorb energy from the Sun so the spider-bots never run out of power. They also want to keep improving the robots so they are tougher, faster, smaller, and smarter to be used on longer missions in space. Many scientists believe that this is the century of robots.

1. How can spider-bots help space exploration?

2. Why is the idea of solar power being considered to energize the spider-bots?

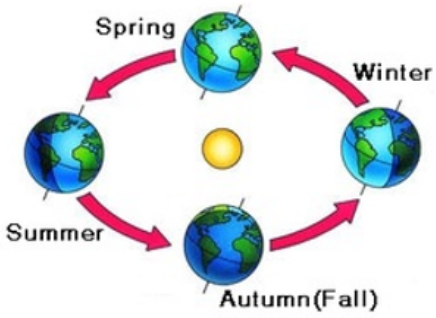
3. Why do you think scientists believe this is the century of robots?

Name _____ Date _____

What is an Orbit? #1

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

The Earth moves around the sun. It moves in a path. The path that one object in space moves around another is called an orbit. All of the other planets move around the sun, too. The planets move in an oval shape. Did you know it takes one year for Earth to orbit the sun?



Tilted Earth orbiting the Sun
http://latandgrat.weebly.com/latitude.html

As Earth moves, it tilts. It tilts on its axis. The axis is an imaginary line that runs through the center of Earth. In summer, Earth tilts toward the sun. The days are longer and warmer because of the sun's light. That is the opposite of winter. In winter, Earth tilts away from the sun and it gets less light. The temperatures are colder.

1. What moves around the sun?

2. What is an orbit?

3. What shape are the planets' orbits?

4. How long does it take for Earth to orbit the sun?

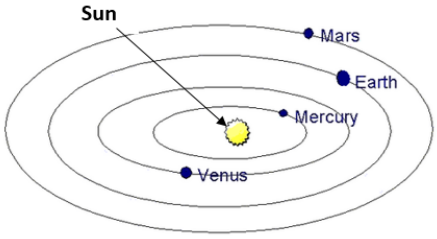
5. Compare how Earth tilts to make summer and winter.

Name _____ Date _____

What is an Orbit? #2

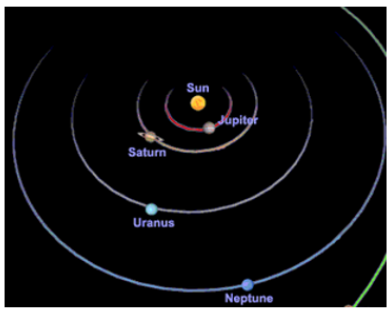
Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

An object's obit is the repeating path it takes to go around another more massive object in space. The planets are held in orbit by the sun's gravitational pull. Each of the planets orbits the sun in an elliptical (oval) path. The farther the planet is away from the sun, the longer it takes for the planet to orbit the sun.



Inner planets
http://www.spaceacademy.net.au/library/notes/venustransit.htm

The inner planets are the four planets closest to the sun: Mercury, Venus, Earth, and Mars. They are often called terrestrial planets as they are made up of mainly rock and metal. They have solid surfaces, no rings, and few satellites.



Outer planets
www.astroplot.com

The outer planets consist of Jupiter, Saturn, Uranus, and Neptune. These are called Jovian planets or gas planets. They are larger than the inner planets and are made up of hydrogen and helium. They have deep atmospheres, rings, and many satellites.

Many planets have moons that orbit them, too. The Earth has one moon that orbits it. Besides the planets, there are comets, asteroids and other objects in the solar system that orbit the sun.

1. Describe in your own words what is meant by an object's orbit.

2. What does the distance of a planet have to do with the length of time it takes to orbit the sun?

3. Name two objects besides the planets that orbit the sun.

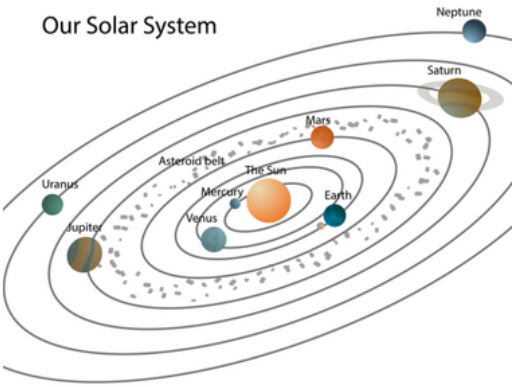
4. Compare the inner and outer planets. Explain at least 5 differences.

Name _____ Date _____

What is an Orbit? #3

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

An object's orbit is the path it takes to go around another object in space. Orbits vary in shape. All orbits are elliptical, which means they are similar to an oval or flattened circle. All of the planets orbit around the sun. Those that are further from the sun, known as the outer planets, take longer to orbit. These include Jupiter (483.8 million miles from the sun), Saturn (886 million miles from the sun), Uranus (1.8 billion miles from the sun), and Neptune (2.8 billion miles from the sun). The inner planets are closer to the sun and their orbits are shorter. These include Mercury (36 million miles from the sun), Venus (67 million miles from the sun), Earth (93 million miles from the sun), and Mars (142 miles from the sun).



kidspressmagazine.com

Earth has an orbital period of one year. This means it takes one year to make one full orbit around the sun. The Earth and the other planets stay in orbit because of momentum, the tendency to move in a straight line, and the force of gravity pulling the planet back. This balance between an object's momentum and the force of gravity allows the object to orbit.

Many of the planets have moons that orbit around them. Earth has one moon. Astronomers know that large rocky bodies called asteroids, icy objects called comets, and millions of smaller rocks called meteoroids also orbit the sun. Most of these objects move along an imaginary flat surface called the ecliptic plane.

1. Define an orbit and explain its shape.

2. Explain the difference between the inner and outer planets' orbits.

3. How is Earth's orbital period measured?

4. Why do the planets stay in orbit?

5. Name three other objects that orbit the sun.

6. What is meant by the ecliptic plane?

Name _____ Date _____

What is it Like to Live Inside a Space Station? #1

Next Generation Science Standards (Science and Engineering Practices – Obtaining, Evaluating, and Communicating Information gr. 5)

There is no gravity in a space station. Scientists have to strap themselves to the walls when they work so they don't float away. The walls, floor, and ceiling are painted different colors to tell which way is up and down. The scientists work out for 2 hours every day in the gym. This helps them keep their bones and muscles strong. They run on the treadmill, row a rowing machine, and pedal the exercise bike. They are trained in first aid.

pixshark.com

The scientists sleep in a module. Sleeping bags are fixed upright on the walls. This helps to keep the scientists secure. Another room is used for eating and relaxing. There is a large table and a place to keep their belongings. In their free time, they can email friends, draw, play games, read, or look at Earth from the window. They can watch movies on their laptops and make phone calls using a hook-up on their computers.

The scientists use foot straps so they don't float away when they go to the bathroom. The space potty uses suction to flush. Since there is no freezer, refrigerator, stove, or microwave, most of the food they eat has already been cooked. It is freeze dried and vacuum packed to take out the water and air, and it is sealed to keep from spoiling. The scientists need to add water and warm the food up in a small warming oven.

1. Describe how a scientist spends his day in a space station.

2. How is life different in a space station from living on Earth?

Name _____ Date _____

What is it Like to Live Inside a Space Station? #2

Next Generation Science Standards (Science and Engineering Practices – Obtaining, Evaluating, and Communicating Information gr. 5)

Since there is no gravity in a space station, scientists have to strap themselves to the walls when they work so they don't float away. They need to put on foot straps when they use the space potty, too. The toilet uses suction. The space station walls are painted different colors, as well as the floor and ceiling, so the scientists can tell which way is up and down.

imgbuddy.com

Their daily work consists of cleaning and checking equipment, maintaining and repairing broken equipment, and conducting science experiments. They exercise for two hours a day in the well-equipped gym. There is a treadmill, rowing machine, and an exercise bicycle. The scientists are trained in CPR and first aid.

A room called the wardroom is used for eating and relaxing. Popular free time activities include emailing friends, drawing, playing games, reading, or observing Earth from the window. They can also watch movies on their laptops and make phone calls using a hook-up on their computers. Surprisingly, the phone calls are very clear. Sleeping bags are fixed upright on the walls in a sleeping module to help keep the scientists secure when they need to rest.

The food they have to eat is usually freeze dried and vacuum packed to eliminate spoilage. Water is added and the food is warmed up in a small warming oven before eating.

1. What are some adjustments made to the space station because there is no gravity?

2. How does a scientist spend his time in a space station?

3. From reading this text, what are some difficulties that scientists living in space experience?

Name _____ Date _____

What is it Like to Live Inside a Space Station? #3

Next Generation Science Standards (Science and Engineering Practices – Obtaining, Evaluating, and Communicating Information gr. 5)

Since there is no gravity in a space station, scientists have to strap themselves to the walls when they work and put on foot straps when they use the space potty, so they don't float away. The space station walls are painted different colors, as well as the floor and ceiling, so the scientists can tell which way is up and down. In addition, sleeping bags are fixed upright on the walls inside the habitation module so the scientists are secure when they sleep.

The scientists' daily work consists of cleaning and checking equipment, maintaining and repairing broken equipment, and conducting science experiments. They exercise for two hours a day in the well-equipped gym. There is a treadmill, rowing machine, and an exercise bicycle to help keep their bones and muscles strong.

The wardroom is used for eating and relaxing with popular free time activities: emailing friends, drawing, playing games, reading, observing Earth from the window, watching movies on their laptops, and making phone calls using a hook-up on their computers.

The food is usually freeze dried and vacuum packed to eliminate spoilage. Water must be added and the food warmed in a small warming oven before eating. Staying healthy while in space is essential.

hd.cool-wallpapers.us

1. How do scientists compensate for not having gravity in the space station?

2. Describe a typical day in the life of a scientist in a space station.

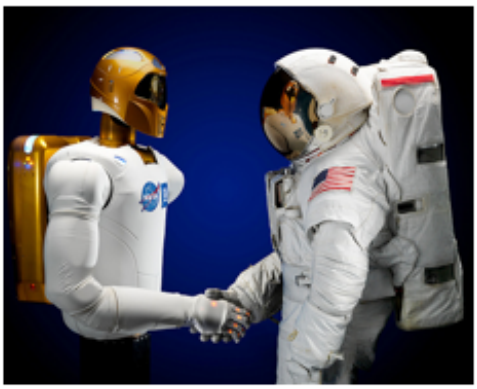
3. What types of activities are important to do every day in the space station?

Name _____ Date _____

What is the Future for Robots in Space? #1

Next Generation Science Standards (Engineering, Technology, and Applications of Science gr. 5)

In the future, robots will be able to do more things. They will go to places that people will never be able to go. The robots will be faster and smarter than they are today. They will be able to work longer before recharging.



scifiward.com

By 2020, NASA scientists want to look for faraway planets. They want to use robots to help. It takes too much time for a human to travel that far. Scientists want to use robots to look through large telescopes in space. They hope that the robots can find new planets.

They want to send astronauts to Mars. Before this trip, scientists want to send teams of robots to make buildings for the astronauts to live and work in. The robots need to lift and carry parts of the buildings. They need to put them together. They need to communicate with each other and work well together.

1. Name 3 ways robots will be different than they are today.

2. How can robots help to find new planets?

3. Why are robots needed for the Mars space trip?

Name _____ Date _____

What is the Future for Robots in Space? #2

Next Generation Science Standards (Engineering, Technology, and Applications of Science gr. 5)

The robots of the future will be able to do more things than humans can do. They will be able to go to places that people will never be able to go. The robots will be faster and smarter than today's robots. They will be able to work longer periods of time before recharging.

By 2020, NASA scientists plan to search for faraway planets with the help of robots. Human beings cannot travel that far in their lifetime. Scientists want to use robots to look through large telescopes in space so they can hopefully discover new planets. The telescopes are being built now.

robonaut.jsc.nasa.gov

Another plan that scientists have is to send astronauts to Mars shortly after 2020. Before this date, they want to send teams of robots to Mars to make buildings for the astronauts to live and work in. The robots need to lift and carry parts of the buildings and put them together. Scientists are working on ways that the robots can communicate with each other and how they can be trained to work in teams. The team concept will help the work to get done faster and also it will help if one of the robots gets damaged.

1. Name 3 ways that future robots will be different than they are today.

2. How can robots help the scientists discover new planets?

3. What purpose will robots play in the 2020 science exploration to Mars?

Name _____ Date _____

What is the Future for Robots in Space? #3

Next Generation Science Standards (Engineering, Technology, and Applications of Science gr. 5)

The robots of the future will be faster and smarter than today's robots. The work required of them will be more complex. They will be able to work longer periods of time before they need to be recharged. They are being built to do things that humans cannot do and to go places that humans cannot go.

robonaut.jsc.nasa.gov

By 2020, NASA scientists plan to search for faraway planets with the help of robots because humans cannot travel that far in their lifetime. Scientists want to use robots to look through large telescopes in space so they can hopefully discover new planets. The telescopes are being built now.

Another plan that scientists have is to send astronauts to Mars shortly after 2020; prior to this time, they want to send teams of robots to Mars to construct buildings for the astronauts to live and work in. The robots need to lift and carry parts of the buildings and assemble them. Scientists are researching ways that the robots can communicate with each other and how they can be trained to work in teams. The team concept will help the work to get done faster and also it will help as a backup if one of the robots should get damaged.

The future for robots in space is bright. It is an exciting time for space exploration and the use of space robots.

1. How are robots of the future being designed so they can handle more complex work?

2. Why do humans need robots to help search for faraway planets?

3. What purpose will robots play in the 2020 science exploration to Mars, and into the future for space exploration?

4. How can robots help space exploration?

5. Why is the idea of solar power being considered to energize the robots?

6. Why do you think scientists believe this is the century of robots?

Name _____ Date _____

What is the International Space Station (ISS)? #1

Next Generation Science Standards (Science and Engineering Practices – Obtaining, Evaluating, and Communicating Information gr. 5)

Scientists live and work in the International Space Station (ISS) that orbits the Earth 15 times a day. They have labs to do science experiments. They also test space equipment for future trips to the Moon or to Mars.

www.learningbeyondthebook.com

The space station is as large as a football field. It has 2 bathrooms, a gym, and many other rooms. About 40 space flights helped bring parts and equipment to the ISS to build it. There were more than 170 spacewalks to have astronauts put everything together. The cost was over $150 billion dollars.

Batteries power the space station. These are recharged at stations in space. Sometimes, the ISS needs a boost from the attached small rocket engines to keep the same speed and altitude. Oxygen to breathe is made in the station. Carbon dioxide is sent out into space. Water is recycled. There is special equipment to bring heat and the sun makes electricity. Then the scientists can be safe and healthy.

1. What is the ISS?

2. What helps the space station move?

3. Why do you think it cost so much to build the ISS?

Name _____ Date _____

What is the International Space Station (ISS)? #2

Next Generation Science Standards (Science and Engineering Practices – Obtaining, Evaluating, and Communicating Information gr. 5)

techalive.mtu.edu

The International Space Station (ISS) is a human-made satellite that orbits the Earth about 15 times a day. It is over 350 feet long, about the size of a football field. It weighs nearly 925,000 pounds. The ISS has 2 bathrooms, a gym, and more room than a 6-bedroom house.

The ISS was built to serve as a space environment research lab. Here, scientists could conduct experiments in science areas like biology, physics, astronomy, and meteorology. They could also test spacecraft systems and equipment for possible missions to the Moon or Mars.

The space station has had scientists living in it since 2000 and has been visited by astronauts and cosmonauts from 15 different countries. There have been more than 350 flights to ISS. 174 spacewalks outside the modules have been conducted to help with construction and maintenance of the satellite. It has cost about $150 billion to make.

1. What is the purpose of the International Space Station?

2. Why do you think the ISS costs so much to build?

3. Describe the size of the ISS.

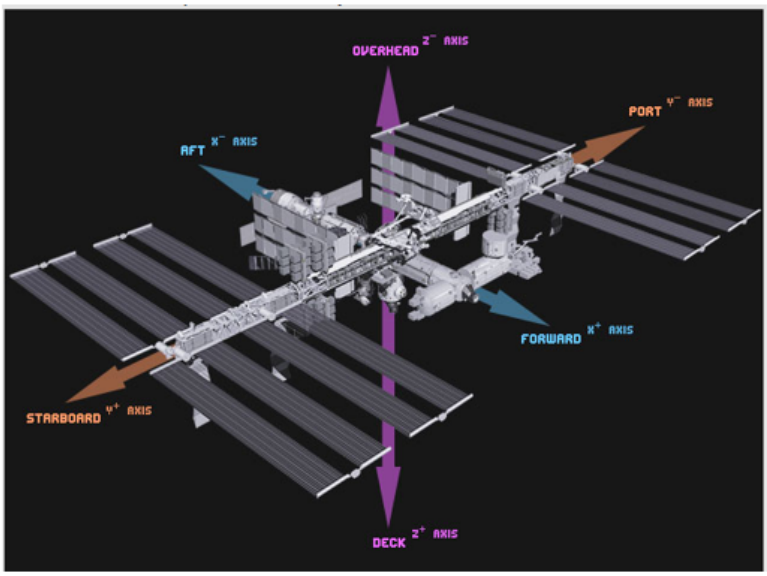
Name _____ Date _____

What is the International Space Station (ISS)? #3

Next Generation Science Standards (Science and Engineering Practices – Obtaining, Evaluating, and Communicating Information gr. 5)

The International Space Station (ISS) is a habitable human-made satellite that orbits the Earth about 15 times a day, at an altitude between 205-270 miles. The ISS has modules for the astronauts to live in. Because of its size, the ISS was made in space through various stages. The first part was sent to space in 1998 on a Russian rocket called Zarya. Two weeks later, NASA launched a module called Unity aboard the Space Shuttle Endeavour. Unity was equipped with everything for humans to live. All totaled, there have been 174 spacewalks outside the modules to help with construction and maintenance. The ISS has cost $150 billion to make.

The ISS is the largest artificial body in orbit, at 357 feet long, the size of an American football field. It weighs more than 900,000 lbs. The ISS has 2 bathrooms, a gym, and more room than a 6-bedroom house.



www.nasa.gov

The space station was built as a space environment research laboratory and observatory. Scientists can conduct science experiments in biology, physics, astronomy, and meteorology. It was also designed as an opportunity to test spacecraft systems and equipment for possible missions to the Moon or Mars. The first occupants were three Russian cosmonauts in 2000; the space station has been continuously occupied since then. It has been visited by astronauts and cosmonauts from 15 countries with a total of 352 flights. It is a joint effort involving NASA (USA), Roskosmos (Russia), JAXA (Japan), CSA (Canada), and ESA (agencies from France, Brazil, Malaysia, South Korea, and Italy).

1. Explain how the ISS is truly an international space station?

2. How did the size of ISS impact its construction?

3. What are the main purposes of the ISS?

Name _____ Date _____

What is the Solar System? #1

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

Our solar system is a small part of a galaxy. It is called the Milky Way galaxy. Our solar system has many parts. The sun is the center of our solar system. Eight planets go around the sun. We live on planet Earth.

The Milky Way galaxy

What makes up the Solar System? Fill in the blanks.

Earth	**galaxy**	**Sun**	**eight**

1. We live on planet _____.

2. The _____ is the center of our solar system.

3. There are _____ planets.

4. Our solar system is part of the Milky Way _____.

Name _____ Date _____

What is the Solar System? #2

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

The sun and the other space objects that move around the sun make up our solar system. Some of these space objects are planets. A planet is a large object that moves around the sun. There are eight planets: Jupiter, Saturn, Uranus, Neptune, Mercury, Venus, Mars, and Earth. We live on the planet called Earth. It is the third planet from the sun. Our solar system is part of a large collection of stars called the Milky Way galaxy. Our sun is just one of 200,000 million stars that make up the Milky Way. This galaxy is shaped like a disc with a bulge in the middle. It got its name because it looks like spilled milk. Together, all of the galaxies and everything else in space are known as the Universe.

The Milky Way galaxy

What makes up the Solar System? Fill in the blanks with the right words.

Earth	**planet**	**eight**	**solar system**	**disc**
Milky Way	**200,000 million**	**universe**		

1. The sun and space objects that move around the sun make up the _____.
2. The Milky Way galaxy is shaped like a _____.
3. A _____ is a large object that moves around the sun.
4. The solar system has _____ planets.
5. All of the galaxies and everything else in space is known as the _____.
6. The _____ is the third planet from the sun.
7. Our solar system makes up the _____ galaxy.
8. There are _____ stars that make up the Milky Way.

Name _____ Date _____

What is the Solar System? #3

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5)

The Milky Way galaxy

Our solar system is a tiny speck in outer space. The universe is everything in outer space, most of which is empty space. This includes all the galaxies and their stars, planets and moons. There are billions of galaxies in the universe and no one really knows how big it is. Within each galaxy are millions of stars held together by gravity. There are over 60 moons and millions of asteroids (rocky bodies), meteoroids (smaller rocks), and comets (icy objects). Scientists have discovered that the universe continues to grow larger and larger. Our solar system lies within the spiral-shaped Milky Way galaxy. The sun is at the center of the solar system. There are eight planets, including the planet Earth that we live on. These planets all orbit the sun in elliptical (oval) paths.

What makes up the Solar System? Fill in the blanks with the right words.

universe	**empty space**	**galaxies**	**Milky Way galaxy**	**sun**	**eight**	**orbit**
scientists	**spiral-shaped**	**elliptical**	**asteroids**	**meteoroids**	**comets**	

1. The planets all _____ the sun.
2. The _____ is everything in outer space.
3. Most of outer space is _____.
4. There are billions of _____ in the universe.
5. The Earth is one of _____ planets in our solar system.
6. The _____ is the center of the solar system.
7. Our solar system lies within the spiral-shaped _____.
8. _____ have discovered that the universe is continuing to grow larger and larger.
9. Our Milky Way galaxy is _____.
10. The planets orbit the sun in _____ paths.
11. Another word for rocky bodies that orbit the sun - _____.
12. Another word for smaller rocks that orbit the sun - _____.
13. Another word for icy objects that orbit the sun - _____.

Name _____ Date _____

What was the Apollo 13 Mission? #1

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5, Engineering Design gr. 5)

The Apollo 13 is a spaceship. It lifted off on April 11, 1970. There were three astronauts. They were going to land on the moon. They were going to study it. There was a loud bang. Part of the spaceship did not work. The men needed to try to get back to Earth safely. They did not have much food or water. It was cold. After four days, the spaceship went around the moon. The men worked hard to get back to Earth. They landed in the ocean water. A ship picked them up. They were happy to be safe.

www.space.com

1. What were the Apollo 13 astronauts going to study?

2. What happened after the loud bang?

3. How did the author end the story?

Name _____ Date _____

What was the Apollo 13 Mission? #2

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5, Engineering Design gr. 5)

cagematch.dvorak.org

The Apollo 13 Mission was to go into space. The astronauts were going to land on the moon to study it for two days. But something went wrong with the spaceship. There was a loud noise and a part of the spaceship was destroyed. The men could not land on the moon. They had to move from the command module into a different part of the spacecraft to stay alive. This part, called the lunar module, was cold. The astronauts did not have a lot of food and water. The spaceship circled the moon. The men moved back into the command module that had a heat shield. They needed protection from the heat when they entered Earth's atmosphere. Then they let the lunar module go. The astronauts landed in the Pacific Ocean. The 3 astronauts, James Lovell, John Swigert, and Fred Haise, were finally home safe!

Put these events in order of when they happened. Number from 1-9 on the blanks.

_____ Loud noise; spaceship destroyed

_____ Apollo 13 blasts off

_____ Moved from command module to lunar module

_____ Landed in Pacific Ocean

_____ Men moved back into command module

_____ Let the lunar module go

_____ Spaceship circles the moon

_____ Spaceship entered Earth's atmosphere

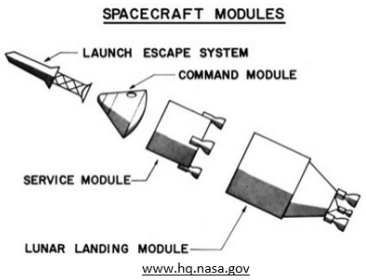
_____ Back home safe

Name _____ Date _____

What was the Apollo 13 Mission? #3

Next Generation Standards (Earth-Space Science gr. 5, Physical Science gr. 5, Engineering Design gr. 5)

Apollo 13 was the United States' space program's third mission to the moon. Apollo 11's successful mission lasted 8 days (July 16-24, 1969). Apollo 11 astronauts landed on the moon for the very first time. The second mission was Apollo 12 and lasted 10 days (November 14-24, 1969). The third mission was Apollo 13 on April 11, 1970. On board were there were 3 astronauts: James Lovell, John Swigert, and Fred Haise.



The spacecraft had a command module, service module, and lunar module. The command module is where astronauts spend most of their time. In it, they conduct experiments and prepare for their moon landing. Most of the supplies like oxygen and fresh water were stored in the service module. The lunar module was designed to supply food and shelter for two people over two days. That was the amount of time that the Apollo 13 astronauts would be on the moon's surface.

However, there was an explosion of the two oxygen tanks and the fuel cells which ruined the command module's electrical systems. Now, there was no light, water, or power. So the astronauts left the command module for the lunar module. They kept the command module for re-entry into the Earth because of its heat shield.

On the way to the moon, an oxygen tank aboard the Apollo 13 spacecraft explodes, triggering one of the most famous space rescues in history.

http://natgeotv.com.au/tv/apollo-13/

The astronauts needed to make the supplies last until they returned home safely. First, they circled the moon and worked on their broken spacecraft. They did not use heat to save energy for their return home. The temperature dropped to 38 ^{o}F. The astronauts drank only a little water each day. Soon the lunar module was filling up with carbon dioxide. They figured out a way to get rid of the gas to stay alive.

After four days, the astronauts re-entered the command module. They powered up the module, buckled themselves into the seats, and released the lunar module into space. They also released the service module. They plunged into the Earth's atmosphere on April 17, 1970 and splashed down in the Pacific Ocean where the astronauts were rescued by sailors on the U.S. ship Iwo Jima.

1. Explain the purpose of the spacecraft's three modules.

2. Label these times and events on the Apollo 13 Timeline:

A) April 13 - Command module ruined
B) return to Earth
C) April 11 - Apollo 13 Launch
D) April 17 - Astronauts move back to command module
E) release other modules
F) April 13-17 - Astronauts stay in lunar module

Apollo 13 Timeline

Name _____ Date _____

Critical Thinking #1: Explain The Apollo 13 Lyrics

CCSS.ELA.Literacy RI 5.1-5.9

Use the *Apollo 13* Graphic Novel and Song to answer the questions.

1. What do the words in the song "*Third stone from the sun*" mean?

_____

2. What do the words in the song "*Cosmic cowboys on a space-bound train*" mean?

_____

_____

3. What was the author's intent when he wrote the lyrics, "*I hope you know the Laws of Newton*"?

_____

4. What is the author referring to in the song lyrics, "*Figure a solution, check the simulator*"?

_____

5. What do the words in the song "*Get them back safe, forget about the crater*" mean?

_____

_____

6. What do the words in the song "*Apollo 13 needs you, Houston*" mean?

_____

_____

7. What do the words in the song "*Tired, wet and freezing, and danger all around*" mean?

_____

_____

8. What does it mean when it says, "They jury-rigged a gizmo to bring CO_2 down"?

_____

_____

Name _____ Date _____

Critical Thinking #2: Explain The Apollo 13 Lyrics

CCSS.ELA.Literacy RI 5.1-5.9

Use the *Apollo 13* Graphic Novel and Song to answer the questions.

1. What do the words in the song "*Seventh manned mission*" mean?

_____

2. What is the root word of cosmic, what does it mean, and what language does it come from?

_____

_____

3. What was the author's intent when he wrote the lyrics, "*liquid-filled fuel tanks pushing 60 tons*"?

_____

_____

4. Do Internet research to find the actual recordings of the transmissions from Apollo 13 to Mission control. Listen to them. Which words in the song did the astronauts actually say?

_____

_____

5. What do the words in the song "*We just heard a rumble*" refer to?

_____

_____

6. Why did the astronauts have to "Button up the tunnel"?

_____

_____

7. Why did the astronauts have to "Check the cabin pressure"?

_____

_____

Name _____ Date _____

Critical Thinking #3: Apollo 13

CCSS.ELA.Literacy RI 5.1-5.9

Use the *Apollo 13* Graphic Novel and Song to answer the questions.

1. How would you compare the danger of having an accident in space versus having an accident on Earth?

_____

2. Why didn't the spaceship just turn around and head back to Earth?

_____

_____

3. Why were they so worried about reentering the earth's atmosphere?

_____

_____

4. In 1970, there was no Internet, so people tuned in to the news of the Apollo mission on TV. How would a similar event be shared in the present? On TV? Where else? How has communication changed?

_____

_____

5. What's one of the ironic things about the name of the mission and the "bad luck" they had?

_____

_____

6. How do you think the astronauts managed to keep calm?

_____

_____

7. What personality traits do you think they needed to have in order to survive and why?

_____

_____

_____

Name _____ Date _____

Reading Comprehension #1

CCSS.ELA.Literacy RI 5.1/5.4

Use the *Apollo 13* Graphic Novel to find answers from the text. Cite the text where you found the answer.

1. What does the acronym NASA stand for?

   On page _____ I found the answer when it said, " _____

   _____

2. What does the Latin word "sol" mean?

   On page _____ I found the answer when it said, " _____

   _____

3. How long does it take for the Earth to orbit the Sun?

   On page _____ I found the answer when it said, " _____

   _____

4. Name the planets in the solar system.

   On page _____ I found the answer when it said, " _____

   _____

5. How many miles away is the Earth from the Sun?

   On page _____ I found the answer when it said, " _____

   _____

6. Name four different types of stars.

   On page _____ I found the answer when it said, " _____

   _____

7. What causes the North Pole to get 24 hours of sunlight a day?

   On page _____ I found the answer when it said, " _____

   _____

Name _____ Date _____

Reading Comprehension #2

CCSS.ELA.Literacy RI 5.1/5.4

Use the *Apollo 13* Graphic Novel to find answers from the text. Cite the text where you found the answer.

1. Explain what the Latin word "Geo" means.

   On page _____ I found the answer when it said, " _____

   _____

2. What percentage of the Earth's surface water is saltwater?

   On page _____ I found the answer when it said, " _____

   _____

3. Name the layer of air closest to the Earth's surface.

   On page _____ I found the answer when it said, " _____

   _____

4. How tall is Mr. Everest?

   On page _____ I found the answer when it said, " _____

   _____

5. In which state can you find a ¾ of a mile wide hole that was left by an asteroid hitting the Earth?

   On page _____ I found the answer when it said, " _____

   _____

6. When the sun isn't shining on the moon, how cold can the moon get?

   On page _____ I found the answer when it said, " _____

   _____

7. Who developed the Laws of Gravity?

   On page _____ I found the answer when it said, " _____

   _____

Name _____ Date _____

Reading Comprehension #3

CCSS.ELA.Literacy RI 5.1/5.4

Use the *Apollo 13* Graphic Novel to find answers from the text. Cite the text where you found the answer.

1. What keeps the Earth in orbit?

   On page _____ I found the answer when it said, " _____

   _____

2. At what temperature does water freeze?

   On page _____ I found the answer when it said, " _____

   _____

3. At what temperature does water boil?

   On page _____ I found the answer when it said, " _____

   _____

4. Explain why the letter V is used in "Saturn V".

   On page _____ I found the answer when it said, " _____

   _____

5. What was Saturn V's fuel tank filled with?

   On page _____ I found the answer when it said, " _____

   _____

6. The first stage of the Saturn V Rocket traveled to a height of _____ miles.

   On page _____ I found the answer when it said, " _____

   _____

7. Why did the NASA team pick Cape Canaveral as a place to launch Apollo 13?

   On page _____ I found the answer when it said, " _____

   _____

Answer Key – Apollo 13 – *Science in Space* & *Learn About Apollo 13* – Song &Graphic Novel

1) How Are Astronauts Protected in Space? #1 Accept reasonable answers.

1. The suit keeps the sun's heat away. It also keeps the astronauts warm.
2. A backpack carries air, water, and a rocket that is used to help astronauts fly around.
3. A camera helps other people know what an astronaut does in space.

2) How Are Astronauts Protected in Space? #2 Accept reasonable answers.

1. Space can be both hot if the sun is shining and cold if the sun is not shining.
2. A spacesuit's backpack carries oxygen to breathe, water to drink, and a place to get rid of body waste.
3. A rocket-powered backpack helps the astronaut fly around in space and not have to be connected to the spacecraft.
4. An astronaut has a camera so other crew members and scientists on Earth can tell what the astronaut is seeing.

3) How Are Astronauts Protected in Space? #3 Accept reasonable answers.

1. There are many features of a spacesuit that protect the astronaut from the sun. Three of these features include having dozens of layers of materials to offer protection from the sun's rays and dust particles; a special visor to help protect the eyes from solar radiation; and the color of the suit (white) to reflect the sun's light.
2. A life-support system was added to the astronaut's backpack so the astronauts can survive in space for short periods of time. This suit includes oxygen to breathe and water to drink. It is also built to remove dangerous carbon dioxide that is exhaled.
3. The text talks about the important purpose of the Manned Maneuvering Unit. It is designed to help astronauts move through space. It has small thrusters for the astronauts to adjust their positions and to move more quickly through space despite their bulky spacesuits. The unit is operated by a hand control.

4) How Do Rockets Get Into Space? #1 Accept reasonable answers.

1. A rocket moves the opposite way of the air (just like a balloon moves). The gases push the rocket up.
2. The fuel makes the rocket heavy. But the rocket needs the huge amounts of fuel to get out of the Earth's gravity.
3. When rockets use up fuel, a certain part falls off. So then the rocket becomes lighter so it can move faster and easier in space.

5) How Do Rockets Get Into Space? #2 Accept reasonable answers.

1. Rockets burn off lots of fuel at takeoff because the rocket needs to escape Earth's gravitational pull.
2. Each section of the rocket has its own engine, fuel, and oxygen tank.
3. A section of a rocket is let go because it is no longer needed when the fuel it carries is used up. This way, when the section is let go, the rocket itself becomes lighter, and thus it is easier to move throughout space. It can also move more quickly.

6) How Do Rockets Get Into Space? #3 Accept reasonable answers.

1. The principle of action and reaction is known as Newton's third law of motion. The hot gases fire backwards from the engine of the rocket to produce an equal force that pushes the rocket forward.
2. The rocket must reach speeds of at least 25,000 miles per hour so the rocket can escape the Earth's gravity.
3. Air pressure is helpful to a rocket: the internal pressure inside the rocket engine has to be greater than the outside pressure that escapes. Then after the rocket goes up and out into space, the pressure becomes less. The changing mass of the rocket is another important factor for rocket propulsion. As more gases are burned, the total mass of the spaceship decreases. This allows less resistance to change in motion. The results of this are an increase in upward acceleration of the rocket.

7) How Hot Is the Sun? #1 Accept reasonable answers.

1. The student lists any 3 facts about the sun: hot, made of burning gas, large, a star, center of the Solar System, closer to the sun than any other star, seen in the day, supplies energy, etc.
2. The sun looks so big because it is closer to the Earth than any other star.
3. The sun's light hides the other stars so you can't see them in the daytime.
4. The sun makes light and heat to warm the land and water. It also gives off energy.

8) How Hot Is the Sun? #2 Accept reasonable answers.

1. If the sun were hollow, one million Earth-sized planets could fit inside.
2. The core is the hottest part of the sun. It is hotter than 27 million ^{o}F!
3. Gamma rays are created by the energy in the sun's core and then they travel outward of the sun.
4. People use binoculars or telescopes to look at the sun. The sun is very hot and can be dangerous to your eyes.

9) How Hot Is the Sun? #3

1. The sun's heat and light are produced by nuclear reactions deep in the sun's core. These reactions produce and release tremendous quantities of heat and light.
2. The currents rise and fall in the outer layers that carry the heat outward from the core. The currents move faster than 2,000 miles/hour.
3. The sun's heat and light are necessary for the plants and animals to live on Earth.
4. They want to look more closely at the sun, but because it is dangerous for their eyes, they need to use long-range instruments based on Earth.

10) What Do Satellites Do? #1 Accept reasonable answers.

1. The Moon and Earth are satellites because the Moon orbits the Earth and the Earth orbits the Sun.
2. The satellites are sent into space to orbit. They send, receive, and bounce back information to Earth.
3. I think communication(s) satellites are important because they relay TV, radio, telephone, and Internet signals so we can communicate better on Earth.

11) What Do Satellites Do? #2

1. A natural satellite is something that is not man-made. So examples of natural satellites would be the Moon and Earth. Artificial satellites are what man makes and sends into space that can reach their orbits and do jobs that scientists have designed and programmed them to do.
2. Three characteristics of man-made satellites include the ability to carry out a job; having certain parts like an antenna to send/receive information and a power source; and the need to travel faster than 17,500 mph to stay in orbit.
3. Communication satellites relay signals; astronomical satellites view space; earth observation satellites predict weather, make maps, and store data about the environment; navigational satellites provide data for navigational systems around the globe and military satellites observe troop movements and gather intelligence

12) What Do Satellites Do? #3 Accept reasonable answers.

1. The satellites have an antenna to send and receive the information; they also have a power source.
2. They need to travel at a certain speed to stay in orbit (faster than 17,500 mph!).
3. The five different satellites and their uses include communications to relay different communication signals back to earth; astronomical to observe objects in space; earth observation to predict the weather conditions, collect data about the environment, and to create maps; navigational to provide for global navigational systems; and military to observe troop movements and gather intelligence and to provide military communication and navigation.

13) What Do We Know About the Moon? #1 Accept reasonable answers.

1. The Earth is 4 times larger than the moon.
2. The moon spins as it moves around the Earth.
3. Accept any 5 answers the student learned about the moon from reading the text:
   quiet; no plants or animals live there; no oxygen to breathe; no weather; the sky is dark; gray rocks and dust cover the surface; surface is flat, but there are mountains and valleys; lots of craters; no atmosphere; very hot in the day and very cold at night.

14) What Do We Know About the Moon? #2

The Venn diagram shows the following (in any order):

Earth: orbits sun, 4 times larger, air and water, plants and animals, sound, sunlight
Moon: orbits Earth, no air or water, no plants and animals, no sound, very hot, very cold
Both: made of rock, same distance from the sun

15) What Do We Know About the Moon? #3

1. The Earth may have man-made satellites that orbit it; but the moon is the only natural satellite (i.e., not man-made) and orbits the Earth once a month.
2. Because the moon has no atmosphere, the moon can't trap the sun's heat to warm it at night or protect it from heat during the day.
3. The phases of the moon are caused by the different amounts of the moon's surface lit by sunlight as the moon orbits the Earth. These phases follow a cycle.
4. The four surfaces of the moon include craters, rugged mountains, walled plains, and circular seas.
5. The photographs from the Russian Luna 3 space probe showed astronomers the far side of the moon. That is the side that we can not see and it was a mystery until the probe traveled behind the moon and sent back photos.

16) What Has Space Technology Taught Us? #1 Accept reasonable answers.

1. Five things that we use on Earth now from ideas in space are: digital watches and clocks, light-weight clothing, microchips, tightly packed foods, solar power, ski goggles that don't fog up, powerless tools and vacuum cleaners, and joysticks for video games.
2. Fill in the blanks
   Scientists have made many things to be used in space. Some of these things have been changed so people can use them on Earth.

17) What Has Space Technology Taught Us? #2 Accept reasonable answers.

1. Scientists adapt space technology to help us in everyday life. In fact, there have been thousands of items that have been invented from space technology that benefit humans on earth.
2. There are many character traits that these researchers need to have. I would think intelligence, creative thinking, being focused and observant, being a problem solver, and showing patience are some important traits to have.

18) What Has Space Technology Taught Us? #3 Accept reasonable answers.

1. I think scientists use many ideas from space technology to adapt and then use for people living on Earth because these things are both useful and beneficial in everyday living and also in the field of advancements in medicine.
2. There are many character traits that I believe space industry researchers need to have to be successful in their careers. Some of these include (being): intelligent, knowledgeable, imaginative, creative, clever, articulate, farsighted, focused, freethinking, observant, intuitive, organized, precise, responsible, and patient.
3. Many of the advancements in medicine have evolved from adaptations from space technology. This is most likely the cause and influence of the people who work in this field and their goal of finding innovative solutions to "problems" faced. For example, the insulin pump, artificial limbs, miniature devices to monitor heart rhythms, MRI scans, reflective blankets, and small TV cameras to aid surgeons in their work are all excellent examples of how advancements in the medical field were made possible through the adaptations of space technology.

19) What is a Space Probe? #1 Accept reasonable answers.

1. Space probes do experiments and take pictures of our solar system so scientists can learn more about it.
2. A lander lands on a planet to do things like study the soil. A flying probe flies around doing their assigned job(s).
3. A space probe is helpful because it can help scientists understand space to better plan for future space trips.

20) What is a Space Probe? #2 Accept reasonable answers.

1. Scientists learn many things from space probes like information about our solar system. They can better understand weather and changes happening on the planets. This helps with future space missions as the astronauts will be better prepared to deal with their missions.
2. Well, they help with future space missions because scientists can better see the planets' surfaces and atmospheres. This helps them plan and design any future missions.
3. There are flying probes that take pictures of things in space; there are others that look at the planets in more detail; and there are landers that actually land on the surface of the planet and study the soil, etc.

21) What is a Space Probe? #3 Accept reasonable answers.

1. Space probes have sensitive equipment on board to help communicate with mission specialists on Earth. Images are transmitted as radio signals to be received by radio telescopes back on earth.
2. Some probes travel quickly by the planets and take pictures. Landers land on the surface of the planets to study soil composition and land formation. Most are powered by electricity generated by solar panels. Some use nuclear generators. A more modern method employs chemical gas.
3. Any time scientists learn more about our universe, and in this case via space probes, it helps them design and plan future space missions and explorations. They can build on what is already known and attempt to find out more.

22) What is a Spider-Bot? #1 Accept reasonable answers.

1. Scientists got the idea for spider-bots from spiders. Spiders have lots of legs and can crawl into small spaces.
2. The spider-bots are helpful because if scientists replace their legs with tools, then they can do work and do experiments in space.
3. Spider-bots are useful to study space because they can be used on long trips and not be recharged if they can get energy from the sun.

23) What is a Spider-Bot? #2 Accept reasonable answers.

1. A spider-bot is similar to a spider in size and therefore, it has the ability to crawl into small spaces. They have many legs to act as feelers and to do work.
2. Scientists keep improving the spider-bots because they want the legs to be replaced with tools. These tools will then be used to dig, repair, and to conduct experiments while exploring space.
3. Spider-bots are useful in space because they can go on long missions and hopefully be recharged by the sun so it is cost-efficient and effective.

24) What is a Spider-Bot? #3 Accept reasonable answers.

1. Spider-bots can crawl into tiny places on the space station to do repairs.
2. Scientists are exploring solar energy for the spider-bots so that the batteries will never have to be recharged. If they can make artificial skin for the spider-bots, then the robots can get their energy from the sun.
3. Scientists believe it's the century for the robot because robots are being designed to be faster, smaller, and smarter and to be able to go on longer missions in space. Then there is almost no limit to their work and contribution to science and space exploration!

25) What is an Orbit? #1 Accept reasonable answers.

1. The Earth moves around the sun.
2. An orbit is the path of one object in space moving around another.
3. The planets move in an oval shape.
4. The Earth takes one year to orbit the sun.
5. Earth tilts towards the sun in summer and away from the sun in winter.

26) What is an Orbit? #2 Accept reasonable answers.

1. An object's orbit is the path that it moves around another object in space.
2. The farther the planet is away from the sun, the longer it takes for the planet to orbit the sun.
3. (The student lists 2 objects that orbit the sun besides planets.)
   Besides planets that orbit the sun, there are comets and asteroids (and other objects).
4. (The student writes at least 5 differences between inner and outer planets.)
   Inner planets: closest to the sun; made of rock and metal; and have solid surfaces (no rings and few satellites).
   Outer planets: gas planets; larger than inner planets; made of hydrogen and helium; have deep atmospheres, rings and may have satellites.

27) What is an Orbit? #3 Accept reasonable answers.

1. An orbit is the path an object takes around another in space and although orbits vary in shape, they are all elliptical.
2. The outer planets take longer to orbit around the sun. The inner planets, closer to the sun, have shorter orbits.

3. Earth's orbital path is measured by one year as it takes one full year for Earth to make an orbit around the sun.
4. The planets, including Earth, stay in orbit because of momentum, the tendency to move in a straight line, as well as the force of gravity pulling the planets back. There is a balance between these two forces (momentum and gravity) so the object remains in orbit.
5. Besides planets, asteroids, comets and meteoroids orbit the sun.
6. The ecliptic plane is the imaginary flat surface where different objects move like asteroids, comets, and meteoroids.

28) What is it Like to Live Inside a Space Station? #1 Accept reasonable answers.

1. An astronaut in a space station works out and studies every day. They have free time to email friends, draw, play games, read, sleep, watch movies, and to make phone calls with the help of their computers.
2. Life is very different inside a space station. There is no gravity. The astronauts must strap themselves to the walls or they will float away. The floor and ceiling are painted different colors so they can tell which is which. They sleep upright in sleeping bags attached to the walls. They have foot straps so they don't float away when they are going to the bathroom. Most of their food has already been cooked so they add water and heat it in a small warming oven. There are no other appliances available to use.

29) What is it Like to Live Inside a Space Station? #2 Accept reasonable answers.

1. There are many adjustments made in the space station so scientists can live and work there because there is no gravity inside. That means that the scientists will float away so they need to be strapped to different things when they work, sleep, and go to the bathroom. The toilet has suction. Also there are no appliances to use for cooking except a small warming oven to heat up the freeze dried food.
2. Surprisingly, the scientists spend their time in the space station doing many things. They work out for a few hours everyday to stay healthy. They study things and conduct experiments. They need to clean, check, and repair the equipment. And they have free time to do many things they are used to doing back on earth. These include: eating and relaxing (resting, reading, drawing, using their computer, listening to music, etc.).
3. I think there are difficulties of living in a space station because the scientists can't move around very easily to work. They must always remember to strap themselves in when doing activities, sleeping, and going to the bathroom. Food preparation is very different. They are limited to a warming oven so the food is freeze dried and vacuum packed to prevent spoilage; you just add water and warm it up.

30) What is it Like to Live Inside a Space Station? #3 Accept reasonable answers.

1. Scientists compensate for lack of gravity in a space station in many ways. They must be conscious that at all times, they strap themselves in some way. That means when they work, sleep, study, have free time, etc. If they don't, they will float away. Since it is easy to get disorientated without gravity, the walls and ceilings are painted certain colors to help them remember. Also, they have to modify their food preparation and have all of the food cooked ahead of time as they then can add water and just warm it up in a warming oven. There are not any other appliances.
2. A typical day includes such activities as exercise, study, work, and relaxation. I am sure the time goes by quickly as there are many things to do and it is more cumbersome to do them in the space station. All of these activities would probably take more time to accomplish if you needed to strap yourself in ahead of time, etc.
3. It is most important that the scientists exercise every day for about 2 hours so they stay healthy and keep their bones and bodies strong so they can conduct the work assigned to them on their important missions.

31) What is the Future for Robots in Space? #1 Accept reasonable answers.

1. Robots of the future will go to new places. They will be smarter and faster than robots are now. They will last longer before having to be recharged.
2. Scientists can use robots to look through telescopes in space to find planets.
3. The robots will make buildings for the astronauts to live in and work on Mars.

32) What is the Future for Robots in Space? #2 Accept reasonable answers.

1. Robots of the future will be different from robots that are used today. They will be able to do more and go places that humans can't go. They will be faster and smarter, and they will even be able to work longer periods of time.

2. Scientists will design the robots to look through telescopes in hopes of discovering new planets because they (the scientists) cannot do this in their own lifetimes; the areas in space that they want to explore are too far away.
3. Robots play an important role in 2020 space exploration to help make buildings for the future astronauts on Mars so they can live and work. Scientists also hope the robots of the future will train together so they can work in teams, help to repair a robot should one get damaged, and also to communicate with each other.

33) What is the Future for Robots in Space? #3 Accept reasonable answers.

1. Future robots will be able to handle more complex work because they will be faster and smarter. They will be able to work long hours without having to be recharged, and do and go places that humans can't.
2. Scientists need robots to search for faraway planets since humans can't go that far in their own lifetimes.
3. Scientists want robots to help construct buildings for the astronauts to live in. They are exploring ways that robots can communicate with each other and how they can work as teams.
4. Robots can help space exploration because they save time and they can expand what humans can do.
5. Solar power will help the robots stay charged without having to recharge them so often or pay a higher price to do so. Energy will not be wasted.
6. Scientists believe it's the century of robots because there is a bright future with many opportunities for robots to help to impact many areas, but most significantly in the field of science.

34) What is the International Space Station (ISS)? #1 Accept reasonable answers.

1. The ISS is the International Space Station. This is where astronauts from NASA and other countries can do science experiments and test equipment for space trips.
2. The space station sometimes gets a boost from the attached small rocket engines so that its speed and altitude can stay the same.
3. I think it probably costs so much money because it is really big and has lots of high tech equipment, etc.

35) What is the International Space Station (ISS)? #2 Accept reasonable answers.

1. The purpose of the ISS is to serve as a space environmental research lab where scientists can conduct experiments and test out spacecraft for future space missions. Scientists have visited from 15 countries.
2. I think it costs so much to build for several reasons: it is really big and has high tech equipment; it needed to be built in stages in space so that costs a lot of money to do.
3. The ISS is over 350 feet long, about the size of football field. It weighs over 900,000 pounds and has 2 bathrooms, a gym, and it's larger than a 6-bedroom house!

36) What is the International Space Station (ISS)? #3 Accept reasonable answers.

1. The ISS is truly an international space station because it is a joint effort between NASA and 8 other countries and agencies. In 2000, the first occupants were 3 Russian cosmonauts and then it was visited by astronauts and cosmonauts from 15 countries! There have been a total of over 350 flights!
2. I am sure the size impacted the construction and the cost. Because of the size, the ISS had to be built in various stages. There have been 174 spacewalks outside the modules to help with construction and maintenance. That costs a lot of money.
3. The main purpose is to serve internationally as a space environmental research lab.

37) What is the Solar System? #1 Fill in the blank.

1. Earth
2. Sun
3. eight
4. galaxy

38) What is the Solar System? #2 Fill in the blank.

1. solar system
2. disc
3. planet
4. eight
4. universe
5. Earth
6. Milky Way
7. 200,000 million

39) What is the Solar System? #3 Fill in the blank.

1. orbit
2. universe
3. empty space
4. galaxies
5. eight
6. sun
7. Milky Way galaxy
8. Scientists
9. spiral-shaped
10. elliptical
11. asteroids
12. meteoroids
13. comets

40) What Was the Apollo 13 Mission? #1

1. The Apollo 13 astronauts were going to study the moon.
2. Part of the spaceship didn't work.
3. The astronauts were back safe on Earth.

41) What Was the Apollo 13 Mission? #2

The student arranges the events in chronological order, using the numbers 1-9:

2 Loud noise; spaceship destroyed
1 Apollo 13 blasts off
3 Moved from command module to lunar module
8 Landed in Pacific Ocean
5 Men moved back into command module
7 Let the lunar module go
4 Spaceship circles the moon
6 Spaceship entered Earth's atmosphere
9 Back home safe

42) What Was the Apollo 13 Mission? #3 Accept reasonable answers.

1. <u>The three modules had different purposes</u>:
   CM: where the astronauts spent most of their time; place to conduct experiments and prepare for moon landing
   SM: where most of the supplies were stored (i.e. oxygen and water)
   LM: this was a place that was built to house two astronauts for two days while the astronauts were on the moon; it contained enough supplies for food and shelter for this time period
2. <u>The student makes a timeline and places the events correctly to include</u>:
   C - A - F - D - E - B
   April 11 – Apollo 13 Launch
   April 13 – Command module ruined
   April 13-17 – Astronauts stay in lunar module
   April 17 – Astronauts move back to command module
   April 17 – release other modules
   April 17 – return to Earth

Answer Key – Apollo 13 – *Learn About Apollo 13* – Graphic Novel

43) Critical Thinking #1 *Apollo 13* Graphic Novel and Song Accept reasonable answers.

1. The words "Third stone from the sun" in the song mean the third planet from the sun which is the earth.
2. The phrase "Cosmic cowboys on a space-bound train" means that the astronauts exploring space and riding on a rocket are compared to the cowboys who settled the Wild West, although the cowboys had a different mode of travel.
3. The author's intent about these lyrics shows that the astronauts needed to use Newton's Laws of Gravity to return the spaceship to Earth safely.
4. In these song lyrics, the author is talking about what the astronauts must do after the engine explosion. They need to figure something out and check the simulator, which is a device that artificially re-creates aircraft flight.

5. These words mean that the astronauts should forget about completing the original mission of exploring the area on Mars named after the large crater. The main goal now is to get back safely to earth.
6. The words "Apollo 13 needs you, Houston" refer to the astronauts request of Mission Control's help.
7. Although it appeared that the astronauts landed in the Atlantic Ocean safely, there could be other harm to them. They could drown, get attacked by a shark, not get rescued in time, etc.
8. The astronauts had to live in Aquarius which was reserved for their return trip. It did not have a heat shield, but there was oxygen to breathe. They had to connect it somehow to get a sufficient amount of oxygen.

44) Critical Thinking #2 *Apollo 13* Graphic Novel and Song Accept reasonable answers.

1. The "Seventh manned mission" was the 7th manned mission is space to fly to the moon.
2. The word "cosmic" comes from the Greek root "cosmo" meaning "order" and "world". So the word "cosmic" means the sum total of everything; the universe.
3. The author meant the fuel tanks of the Apollo had to get enough thrust to launch the rocket against the laws of gravity.
4. "Houston, we've had a problem," is what was said to Mission Control from the astronauts in Apollo 13 when there was engine trouble and the explosion. This compares to the song's lyrics, "Apollo 13 needs you, Houston."
5. The rumble sound that was heard refers to the oxygen tank exploding and crippling the SM on which the CM depended. The tanks exploded when the spaceship was 200,000 miles out into space.
6. They needed to button up the tunnel to seal off the air and ensure that they had oxygen to breathe.
7. The astronauts needed to check the cabin pressure so they could survive.

45) Critical Thinking #3 *Apollo 13* Graphic Novel and Song Accept reasonable answers.

1. The accidents occurring in both of these environments would be very different. If an accident happened on Earth, the people who may help you are easier to find and their response time is faster than if something happened up in space. Plus the people in space only had the equipment and materials in their spaceship to use; here on earth, there are materials and equipment to help out in any type of accident.
2. It wasn't that easy for the spaceship to head back to Earth. The spaceship was in orbit and if they changed routes, the astronauts had to worry about how to do that and if they would have enough fuel, oxygen, etc. to return safely.
3. They would have to break out of the orbit.
4. Today if something happens that is international news, it can be broadcast over the TV immediately and online over the Internet, twitter, etc. ---all much earlier than when it hits the newspapers the following day.
5. It is ironic that the mission was called "Apollo 13" because the number 13 is considered an unlucky number. And, you see, the astronauts had their share of "bad luck" throughout the mission.
6. The astronauts did manage to stay relatively calm. Probably they knew that they needed to work together if they were going to survive this ordeal. So they worked hard, used their knowledge and creative problem solving skills, thought of their families, prayed, tried to rest to reduce stress, etc.
7. I think the astronauts needed to have many personality traits like patience, perseverance, creative problem solving skills, intelligence, etc. I also think that they needed to communicate and work together as a team. They needed to show empathy towards each other so everyone's sprits remained as high as possible to continue to work on a solution. The astronauts needed many of these personality traits if they were going to return safely. They needed to take their time, but never give up on trying to find a way that would work.

46) Reading Comprehension #1 *Apollo 13* Graphic Novel

1. p. 3, "National Aeronautics and Space Administration."
2. p. 17, "Solar comes from the Latin word 'sol' meaning sun."
3. p. 18, "It takes one year, or 365 days to go around the Sun once."
4. p. 19, "Mercury, Venus, Earth, Mars, Jupiter, Uranus, Venus, and Neptune."
5. p. 22, "92,960,000 miles."
6. p. 25, "Red dwarfs, yellow dwarfs, red giants, and blue-white supergiants."
7. p. 30, "the tilting of the Earth on its axis."

47) Reading Comprehension #2 *Apollo 13* Graphic Novel

1. p. 31, "The word 'Geo' which means Earth."
2. p. 32, "75%." (using the globe illustration)
3. p. 36, "the troposphere is the layer closest to the Earth's surface."
4. p. 37, "Mount Everest is about 29,000 feet above sea level."
5. p. 41, "You can visit a crater in the state of Arizona today!"
6. p. 45, "And when the sun isn't shining on the moon, it can get minus 289 ^{o}F."
7. p. 47, "Sir Isaac Newton developed the Laws of Gravity in 1666."

48) Reading Comprehension #3 *Apollo 13* Graphic Novel

1. p. 52, "It (the Earth) can't escape the orbital path around the Sun because the Sun's gravity is pulling on the Earth."
2. p. 60, "If you lower it below 32 ^{o}F, it will start to freeze."
3. p. 61, "212 degrees F, it starts to boil."
4. p. 70, "The V in Saturn V stands for the number 5 because they used Roman numerals."
5. p. 71, "The fuel tank was filled with kerosene, a liquid fuel that people can often see in lanterns."
6. p. 76, "Scientists designed the first stage to take the rocket to a height of 42 miles."
7. p. 83, "The NASA team picked Cape Canaveral because the fuel tanks would fall back safely into the Atlantic Ocean."