STORYPATH®

Creating a Constitution The Space Colony

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Some people believe that our destiny is to build colonies on other planets. Science fiction writers have looked forward to this future, envisioning fast spaceships that explore far-off star systems.

> The closest we've come to building a space colony is the creation of the International Space Station, which has been orbiting Earth since 1998. Though still under construction, the International Space Station currently has the capacity to sustain a crew of three people.

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1. Is building a space colony a top priority for NASA? Explain. (making inferences, scanning)

SET ¹

SLIDE 1

REVIE

Robots in Space

Robotic probes are exploring our solar system. These robots may pave the way for human exploration.

SLIDE 2

Exploring Mars

The exploration of Mars has been an important part of space missions since the 1960s. In 2003, NASA sent a pair of twin rovers to Mars as part of the Mars Exploration Rover Mission. One significant discovery from this mission was the collection of evidence that liquid water was once present on Mars.



SLIDE 3

Robots in Space

Exploring Jupiter

In 1995, **Galileo** was the first spacecraft to maintain an orbit around Jupiter.

Exploring Saturn

The **Cassini** spacecraft entered Saturn's orbit in 2004. **Cassini** also sent a probe onto the surface of Saturn's largest moon, Titan. This mission is still in progress.

Exploring Pluto

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NASA is in the process of beginning the **New Horizons** mission to send the first spacecraft to visit Pluto and its moon, Charon. A small probe is expected to reach Pluto in 2015.

2. Why do you think people want to explore space? (making inferences)

SET 2 **SLIDE 1**

0 Pluto and Charon

BEVIEW



Comets are balls of frozen gases, dust, ice, and rock that orbit the sun. Comets evaporate as they near the sun, forming long tails of gas and dust.

> Asteroids are rocks that vary widely in size. Some are hundreds of miles wide, but most are only a couple of miles across. Most orbit the sun in a belt between Mars and Jupiter.

> > Earth and Moon

Mercury

0 Venus

HOMA ADOPTH What is our solar system?

Uranus

In our solar system, a family of nine planets orbit, or move around, the sun. In turn, smaller objects, called satellites or moons, orbit the planets.

1. How does a planet's distance from the sun affect the possibility that the planet will one day host a space colony? (connecting)

Space Concepts

Mass

Mass is the amount of matter in an object, whether it is spread out in a gas or densely packed in rock.

Gravity

Gravity is a force that pulls any two objects in the universe toward one another. The more mass an object has, the stronger it pulls on other objects. The sun, the most massive object in our solar system, forever pulls on the planets, keeping them in orbit around it. Our planet pulls on you, keeping your feet on the ground and giving you weight. You actually pull back on Earth, but because you are so small there is no noticeable effect on the planet.

Year

The length of a year is the time it takes Earth to travel once around the sun.



SLIDE 2

What are the inner planets?

We are in a neighborhood of the solar system called the inner planets—Mercury, Venus, Earth, and Mars. The inner planets are made mostly of rock. Their surfaces, however, vary greatly. Mercury is scarred by craters. Venus is shrouded in thick clouds of acid. Earth, the largest of the inner planets, teems with life. Mars, smaller than Earth and farther from the sun's warmth, is a cold and harsh world.

Planet Sizes This picture shows the planets drawn to the same scale. Earth's Moon

Mercury Venus Earth Mars

Jupiter

Saturn

Uranus Neptune

SLIDE 1



Mercury

Distance from Sun: 36 million miles (58 million km) **Travel Time from Earth:** 107 Earth days **Surface Temperature:** Day: 800°F (427°C) Night: -300°F (-183°C) Orbits Sun in: 88 Earth days Daylight/Darkness Cycle: 176 Earth days Mass: 0.055 times that of Earth **Gravity:** 0.376 times that of Earth Water: Possible ice in polar regions **Atmosphere:** Very thin Satellites: 0

Venus

Distance from Sun: 67.2 million miles (108.2 million km) **Travel Time from Earth:** 143 Earth days Surface Temperature: 900°F (482°C) **Orbits Sun in:** 224 Earth days 17 hours Daylight/Darkness Cycle: 116 Earth days 18 hours Mass: 0.814 times that of Earth Gravity: 0.903 times that of Earth Water: None **Atmosphere:** Very thick carbon dioxide gas with clouds of acid Satellites: 0

1. Why is Mercury warmer than Venus? *(making inferences)*

Earth

Distance from Sun: 93 million miles (149.6 million km) **Surface Temperature:** 59°F (15°C) **Orbits Sun in:** 365 Earth days 6 hours Daylight/Darkness Cycle: 24 hours Mass: 1 times that of Earth **Gravity:** 1 times that of Earth Water: Abundant liquid water on surface **Atmosphere:** Mostly nitrogen and oxygen Satellites: 1 (the Moon)

Earth's Moon

Distance from Earth: 240,000 miles (384,000 km) **Travel Time from Earth:** 3 Earth days Surface Temperature: Day: 248°F (120°C) Night: -320°F (-160°C) Orbits Earth in: 27 Earth days 8 hours Daylight/Darkness Cycle: 29 Earth days 13 hours Mass: 0.012 times that of Earth **Gravity:** 0.165 times that of Earth Water: Possible ice in polar regions Atmosphere: None

Vlars **Distance from Sun:** 141 million miles (227.9 million km) Travel Time from Earth: 255 Earth days Surface Temperature: -81°F (-63°C) Orbits Sun in: 687 Earth days Daylight/Darkness Cycle: 24 Farth hours 39 minutes Mass: 0.108 times that of Earth Gravity: 0.380 times that of Earth Water: Possible underground lakes and frost mixed with dirt; ice in polar regions Atmosphere: Thin; mostly carbon dioxide gas **Satellites:** 2

2. In what ways is Mars different from Earth? *(comparing and contrasting)*



What are the outer planets?

There are four outer planets. Four of the outer planets—Jupiter, Saturn, Uranus, and Neptune—are many times larger than Earth and have no solid surfaces. They are massive balls of gas held together by gravity. In 2006, the International Astronomical Union defined Pluto as a "dwarf planet."





Jupiter

Distance from Sun: 483.6 million miles (778.4 million km) **Travel Time from Earth:** 2 Earth years 9 months **Average Temperature:** −243°F (−153°C) Orbits Sun in: 11 Earth years 10 months Daylight/Darkness Cycle: 9 Earth hours 55 minutes Mass: 317.8 times that of Earth Gravity: 2.34 times that of Earth Water: Inaccessible water ice and droplets in lower atmosphere Atmosphere: Very thick; hydrogen, helium, and other chemicals Satellites: 16 **Rings:** Dust and gas

Saturn

Distance from Sun: 888.2 million miles (1.4 billion km) Travel Time from Earth: 6 Earth years 5 days Average Temperature: -301°F (-185°C) Orbits Sun in: 29 Earth years 6 months Daylight/Darkness Cycle:

10 Earth hours 26 minutes **Mass:** 95.2 times that of Earth **Gravity:** 1.16 times that of Earth **Water:** Inaccessible water ice and droplets in lower atmosphere **Atmosphere:** Very thick; hydrogen, helium, and other chemicals **Satellites:** 22 **Rings:** Small chucks of water ice



Uranus

Distance from Sun: 1.8 billion miles (2.9 billion km) **Travel Time from Earth:** 15 Earth years 10 months Average Temperature: -323°F (-197°C) **Orbits Sun in:** 84 Earth years Daylight/Darkness Cycle: 17 Earth hours 14 minutes Mass: 14.48 times that of Earth Gravity: 1.15 times that of Earth Water: Inaccessible layer of water and ammonia Atmosphere: Very thick; hydrogen, helium, and other chemicals Satellites: 15 **Rings:** Dark boulders and dust

Neptune

Distance from Sun: 2.8 billion miles (4.5 billion km) Travel Time from Earth: 30 Earth years 6 months Average Temperature: -373°F (-225°C) Orbits Sun in: 164 Earth years 9 months Daylight/Darkness Cycle: 16 Earth hours 2 minutes Mass: 17.2 times that of Earth Gravity: 1.19 times that of Earth Water Inaccoscible layer of water

Water: Inaccessible layer of water, ammonia, and methane Atmosphere: Very thick; hydrogen, helium, and other chemicals Satellites: 8 Rings: Particles and dust

SET 4 SLIDE 4

Pluto—The Dwarf Planet

Distance from Sun: 3.7 billion miles (5.9 billion km) **Travel Time from Earth:** 45 Earth years **Surface Temperature:** -419°F (-233°C) **Orbits Sun in:** 247 Earth years 8 months Daylight/Darkness Cycle: 6 Earth days 9 hours Mass: 0.0025 times that of Earth Gravity: 0.08 times that of Earth Water: Possible water frost on surface of Charon, its moon **Atmosphere:** Very thin; methane and nitrogen Satellites: 1

Other Planets?

In 2005, astronomers discovered an object larger than Pluto more than 9 billion miles from the sun. The object, given the temporary name "2003 UB313," may one day be classified as anoter planet in the solar system.

However, astronomers have found evidence that there are more objects like 2003 UB313 in our solar system. Some scientists believe these objects, which are very similar to Pluto, are not large enough or complex enough to be called planets.

- **1. How do the outer planets differ from the inner planets?** (comparing and contrasting)
- 2. How do new discoveries change what we know about our solar system? (making inferences)



What do we know about space travel?

In order to escape Earth's gravity, spaceships need to travel very fast—about seven miles per second. The two Solid Rocket Boosters that lift the Space Shuttle into orbit generate 5.3 million pounds of thrust, which is enough energy to power 400,000 cars. So spaceships are made as light as possible.

The Space Shuttle



Once a spaceship passes beyond Earth's atmosphere, it enters airless space. No person could survive in space for more than a few seconds without a space suit or spaceship, which must carry enough air, water, and food to keep its explorers alive.

Edwin E. Aldrin, Jr., of the Apollo 11 mission, walks on the Moon.



A History of Space Exploration

The 1950s marked the beginning of the space age. In 1957, the Soviet Union launched Sputnik 1, the first artificial satellite. In 1969, the United States made history when the Apollo 11 mission successfully landed two astronauts on the Moon.

In 1961, Yuri Gagarin boarded the Soviet spacecraft *Vostok One* and became the first human to travel into space.

2. What might be one thing NASA learned from the Apollo missions? (making inferences, connecting)

Courtesy of Errabee under the Creative Commons Attribution-Share Alike 2.5 Generic license.

In the future, how might people travel to another planet? **SLIDE 1** To establish a space colony on another planet, Bathroom, which includes a a huge amount of equipment and supplies water recycling system. To would be needed. How would people transport make the ship lighter, waste water is recycled for use such heavy cargo? during the journey. Bedrooms Kitchen and lounge **Spaceships of the Future** KLAI OFFICIALO Science lab Exercise room

Aerobrake protects the ship as it travels through a planet's atmosphere.

1. Why is it unlikely that a space colony crew would carry all their equipment and supplies on one spaceship? (main idea/supporting details)

The first people who go to another planet might use a small spaceship with enough fuel and supplies for a one-way journey. Robotic cargo ships will provide them with supplies for their stay on the planet surface and for the trip home. <image>

SET 6

SLIDE 2

As a training exercise, a NASA plane flies to a high altitude and falls freely, creating a weightless environment.



IEW

The Risks of Space Travel

Radiation

Earth's atmosphere shields us from harmful cancer-causing radiation that travels through space. Some of the radiation comes from the sun. Other radiation, called cosmic rays, comes from beyond our solar system. Spaceships can be designed to shield astronauts from most of the sun's radiation, and cosmic rays are not very strong. During a mission to another planet, astronauts would be exposed to some radiation, but only enough to slightly increase their risks of developing cancer.

Zero Gravity

During a journey to another planet, astronauts will be floating around in zero gravity. From our experience with space stations, we know that long periods of weightlessness cause muscles and bones to weaken. To slow down the weakening process, astronauts will need to exercise about two hours each day. Another solution to the problem of weightlessness would be to spin the spaceship as it travels through space. This action would create artificial gravity on board.

2. What do you think might be the greatest danger to someone traveling to another planet? (main idea/supporting details, connecting)



How might a space colony be built?

If you were one of the first human visitors to another planet, you would probably only stay for a short time. One of your goals, however, would be to learn how to create a self-sufficient base, or permanent shelter, that may one day become a colony.

Plastic Domes

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Large domes made of transparent plastic would be perfect structures for farms. They might also be used to enclose living areas. The outside of a dome is hard plastic. Inside, a thinner layer of plastic, inflated like a balloon, keeps the air from escaping. On Mars, where days are about the same length as on Earth, plastic domes should trap enough heat to stay comfortable inside. On a place like Earth's Moon, the domes would become too hot during the long periods of sunlight. SLIDE 2

OPTICE



Brick Buildings

A simple and effective building material on another planet might be bricks. As on Earth, soil, water, and heat are all that would be needed to make bricks. The structures could be filled with breathable Earthlike air. A layer of dirt would help maintain a comfortable temperature inside the brick buildings. The dirt also strengthens the buildings and shields them from radiation.



Transportation

Apollo astronauts drove lightweight cars, or rovers, when they explored the Moon. Vehicles will be important tools for future explorers.

What are the challenges to human survival on another planet? (main idea/supporting details)

How might useful resources be found on another planet?



What would people living on another planet need to survive? People in a space colony would need to find ways to grow their own food, generate electricity, and create important materials such as metals and plastics.



OPTION REVIE

Water Processing Plant

Oven heats soil to about 500°C.



SLIDE 2

Dump truck loads soil onto a conveyor belt.

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Liquid water is stored in supply tank.

Water in soil boils, turning into vapor. Water vapor rises into a condenser, where it turns into liquid.

223

The hot water turns to steam, which is used to create electricity.

A pipe brings hot water up to the surface.

Some of the water is used by people at the settlement. The rest is pumped back underground to refill the lake.

The steam becomes liquid water.

Power Plant

The first sources of power on another planet will probably be nuclear power plants imported from Earth. Later, local sources of power, such as sunlight or wind, might be used to generate electricity. If hot underwater lakes exist on a planet, settlements could be built over them. These lakes could be tapped to create electricity with a technique already used here on Earth.

SET 8



Terraforming Mars

The first step in terraforming Mars would be to make the planet's surface warmer. Huge mirrors might be built in orbit around Mars. The mirrors would reflect sunlight onto the planet, heating it up. Once Mars is warmed up and water flows across its surface, the next step would be to add oxygen and nitrogen. Bacteria and plants that are able to change sunlight and carbon dioxide to oxygen could be added to the planet. After several hundred years, people might be able to breathe on Mars without an oxygen mask.

This astronaut is collecting moon rocks to bring back to Earth. People on a future Moon base could use the chemicals inside of Moon rocks to make breathable oxygen and aluminum, a strong, light metal.

- **1. How might people on a space colony make their own breathable air?** (main idea/supporting details)
- 2. What might be some of the challenges to terraforming Mars? (making inferences, scanning)

What is a constitution?

A constitution is a written document that states the basic principles and laws of a nation, a state, or a group of people. During the Revolutionary War, the thirteen states formed a weak central government under the Articles of Confederation. The structure of the federal government was defined and strengthened when the Constitution of the United States took effect in 1789. SET 9

SLIDE 1

1. What might happen if a nation did not have a constitution? (connecting)

Wethe People of the United States, in order to form a more perfect Union, establish

lection. 1. All legistative Powers herein hall be vested in a bongre fs of the United States, which shall consist of a Senate a Representatives .

of Representatives. Hellion 9. The Haye of Representatives shall be composed of members chosen every second year by the Repte of the several Or in each clute what have Qualifications requisite for Cluters of the most numerous Branch of the Plate Legistation . No Clemen what we a Representative whose halt not have attained to the elge of twenty five Types, and been seven types a Citizgo No Clemen what we a Representative whose that not have attained to the elge of twenty five Types, and been seven types a Citizgo

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Representatives and direct Taxes chall be apportioned among the several states which may be included we ng to the whole Number of free Perso three fifths of all other Persons . The actual Onemerction shall be made within the ears, in such Manner as they shall by Law direct . The Number of Representatives sha ade, the State of New Han ach State shall have at Seast one Representative; and until such , Connecticut fore, new york new, New Jerrey entitled to chuse three, Malsachusetts eight, Rhode Sole nia ten, North Carolina five South Carolina

When warners happen in the Repusentation from any Mataple Convert. The House of Repusentatives shall chose their speaker and other officers a hall i fue Writs of Cledion to fills Section . 3. The clenate of the United States shall be composed of worken

Immediately after they shall be afterabled in Consequences of the first Election, they shall be divided as equally of the Senators of the first Clafs shall be vocated at the Expiration of the second year, of the second Clafs at the Expirate Class at the Expiration of the suith year, so that one third may be chasen every second year, and if Decanics has Reach of the Segustature of any state, the Executive thereof manufacte temperary appo

No Person shall be astenator who shall not have al not, when elected, be an Inhabitant of that state for which her The Bree President of the United States shall be Resident. The Senate vhall chose their other Officer, and also a Rea

It have the sole Power to bry

tion . 5. Cach House shall be the Judge of the Clections Returns and Qualifications of its even Mon Querum to do Basing 6; but a smaller hamber may adjourn from day to day and may be ou such Manner and under such Pradice as each House may provide. Cach House may determine the Rules of its Proceedings punisheds Members for disorderly Beha

Cash House shall keep a fournal of is Proceedings and from time to time publish the Some caupting such a Generey and the gross and they of the Montess of this House on any quarter shall at the Dever of the fille phone Fille shall without the Consent of the other, adjourn for more that Section of the other, adjourn for more that han that in which the two Houses the

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No Senator or Representative shall during the Some for which he was elected be appointed to any civil office under the distance of a which shall have been energiand to regard no Poron holding any Office ... Males, hall be a Member of ether House during his C

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The Preamble to the United States Constitution reads:

We the People of the United States, in Order to form a more perfect Union, establish Justice, insure domestic Tranquility, provide for the common defence, promote general Welfare, and secure the Blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution for the United States of America.

Limited and Unlimited Governments

Governments can be divided into two categories: limited and unlimited. A limited government is a constitutional government. In contrast, an unlimited government has all the power to control what happens in a country.

One of the first attempts to set limits on an unlimited government was the Magna Carta. Under the Magna Carta, English kings were, for the first time, required to follow the rule of law.

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The Magna Carta was the first document to set limits on the powers of the English Kings.

SET 9 SLIDE 3

2. Should a space colony ever be governed by a limited government? Explain. (making inferences)

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