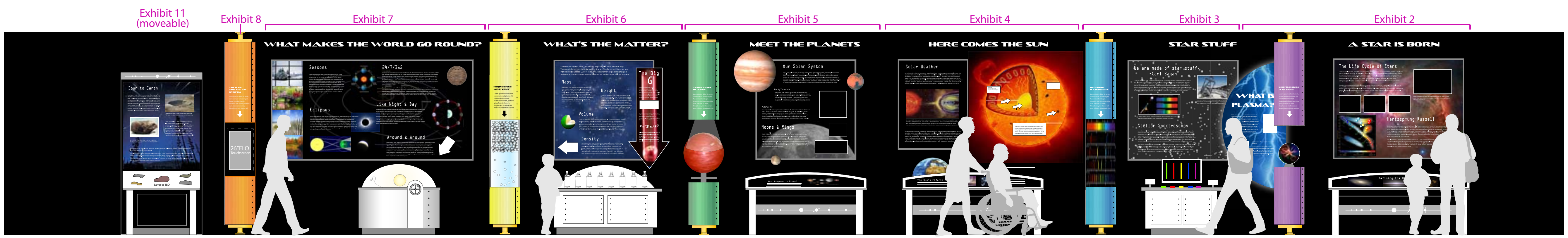
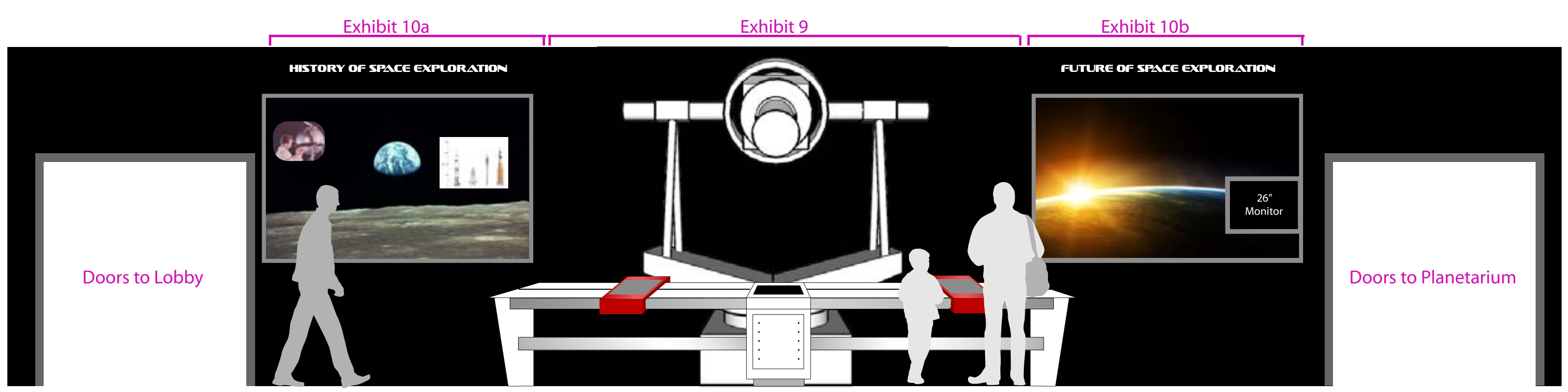
Lobby Wall Elevation



Curved Gallery Wall Elevation



Straight Gallery Wall Elevation

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Project:

MUSEUM of the SOUTHWEST

BLAKEMORE PLANETARIUM

Date:

May 6th, 2009

Drawing:

Color Elevations

G08-01 G06-05 G05-04 G03-04 G02-04

Interactive Column Vinyl

malone design/fabrication

Project:
MUSEUM of the SOUTHWEST
BLAKEMORE PLANETARIUM

Phase:
Final Design

Date:
7/31/09

Drawing:
Column Copy

TOUR OF THE SOLAR SYSTEM

Touch the screen below to learn more about the planets in our solar system!

HOW DENSE ARE YOU?

Compare these two chambers.

They are the same volume, but do they have the same amount of matter in them? Do they have the same density?

Which state of matter do you think each demonstrates?

TURBULENT PLANET

Turn this sphere to imitate Jupiter's atmosphere.

The moving, swirling atmosphere of a gas planet creates the visible patterns on its surface. Turn the sphere at different speeds and in opposite directions.

What happens?

READING RAINBOWS

When a gas is excited by an electric current, it glows with a combination of colors, or spectra. Each pattern of lines is like a fingerprint unique to each element.

LIGHTNING IN A BUBBLE

This sphere contains plasma – hot gases broken into particles by an electric charge. When you touch the glass, your fingers provide grounding for the electricity, creating the same circumstances as those that produce lightning.

Interactive Column Vinyl - ENLARGED FOR PROOFING

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BLAKEMORE PLANETARIUM

Phase:

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Date:

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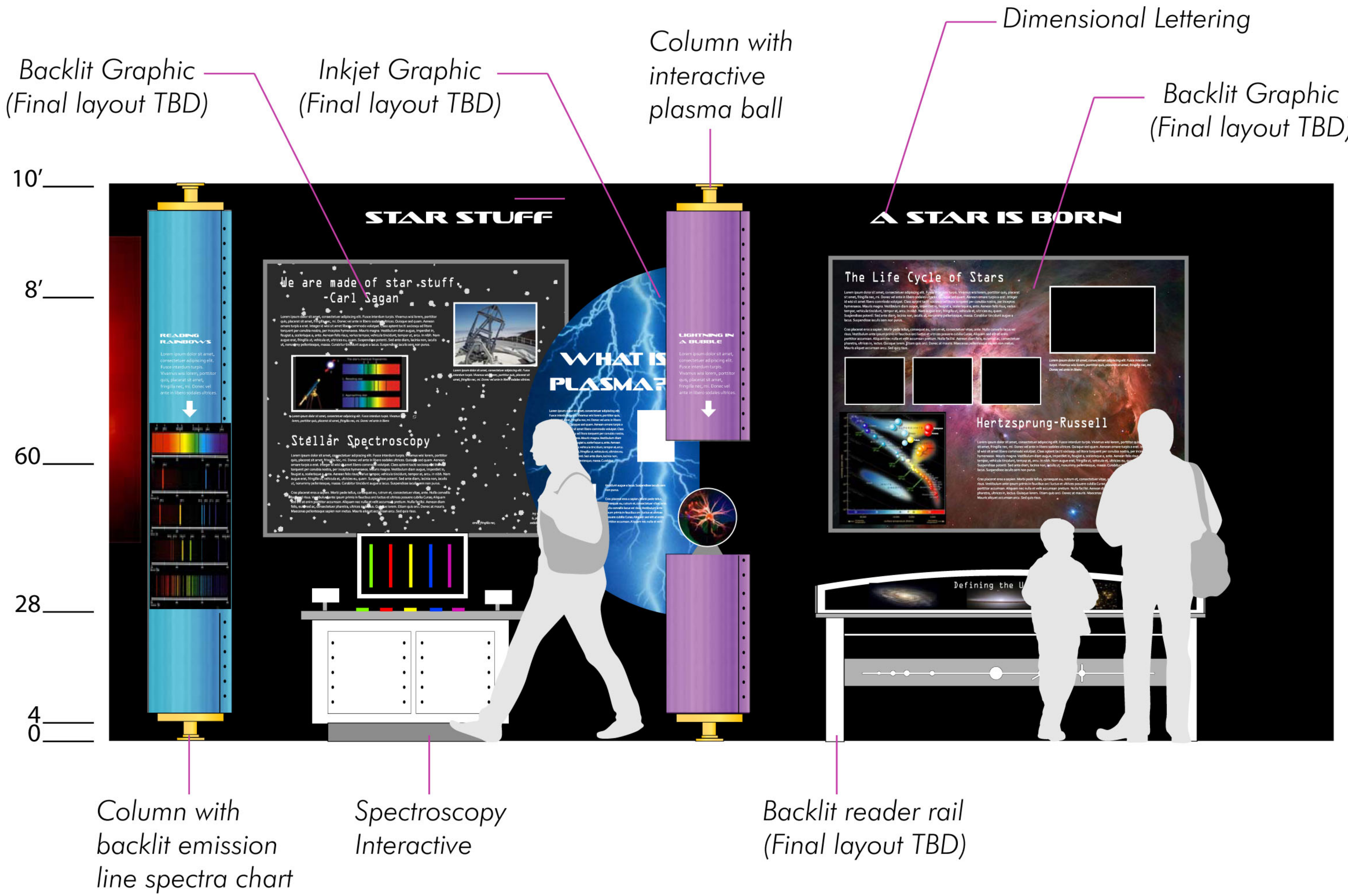

Exhibits 2 & 3 - A Star is Bron & Star Stuff

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Project:

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BLAKEMORE PLANETARIUM

Date:

May 6th, 2009

Drawing:

Exhibits 2 & 3
Color Elevation

white dotted line denotes viewable area

A STAR IS BORN

G02-01 - Dimensional Title - 3" letter height

THE LIFE CYCLE OF STARS

When we look into the night sky we see stars beyond number. To the naked eye most stars look like small pricks of light, but if we could travel there, we could see they are actually very different from one another. Stars vary in size, color, temperature, composition—and in age.

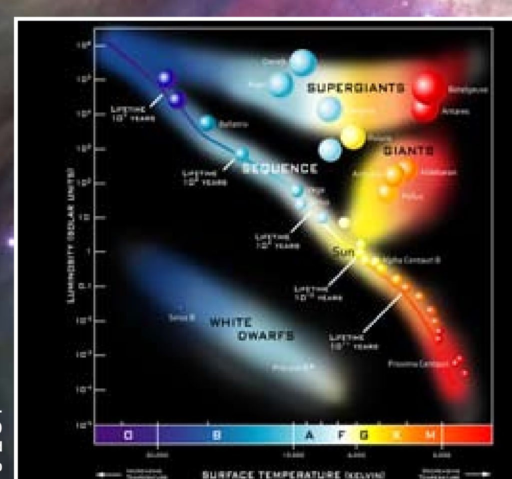
All stars, including our sun, live for billions of years. They are born, they shine and eventually they die. The stars we see in the sky are at all different stages of life.

A FAMILY PORTRAIT OF THE STARS

Scientists make sense of the great variety of stars by classifying them according to their brightness (luminosity) and their surface temperature (also called the color, or spectral class.)

Since brightness and surface temperature change during a star's life, this classification has helped scientists tell a star's phase of life. If your grandmother had millions of grandchildren, she might have to do the same thing!

Astronomers use a diagram called the *Hertzsprung-Russell* (H-R) to illustrate this relationship between brightness and surface temperature for the known stars. The chart is named after the two scientists (Ejnar Hertzsprung and Henry Norris Russell) who developed it in the early 1900s.



Find the Sun on this Hertzsprung-Russell chart. It is roughly 840,000 miles (1,400,000 km) across, with a surface temperature of around 9,000ºF (5,.500ºC.) How does it compare to the other stars? What color is it?

BIRTH

Stars are born in clouds of dust and gas called *nebulae*. The dust and gases, mostly hydrogen and helium, are pulled together by gravity to form dense clumps. The clumps continue to collapse inward to form a star's core.

As the core contracts, the gases inside grow hotter and hotter. Eventually, nuclear fusion starts, huge amounts of energy are released, and the star begins to shine.

DEATH

Eventually a star's supply of gas runs out. At that stage of life, a star such as our sun will swell up and turn red until all the gases on the outside are burned off. The remaining core, called a *white dwarf*, will cool off and fade away.

Much larger stars than our sun might instead explode into *supernovae*—massive clouds of star material. A supernova might have at its core a very dense neutron star or a black hole.

Material from dead stars eventually clumps together into nebulae where new stars are born.

WHAT TYPES OF STARS ARE THERE?

Each dot on the Hertzsprung-Russell chart represents a star. The height of a star on the chart (its vertical axis) tells how bright the star is. Its position from left to right (its horizontal axis) tells the surface temperature, or color.

Ninety percent of known stars occur in the diagonal band from upper left (hot and bright) to lower right (cooler and less bright), called the Main Sequence. Stars in this area generate energy mainly from hydrogen-to-helium nuclear fusion reactions in the core. This is what most stars are like for the bulk of their lives.

Stars above or below the Main Sequence are at later phrases of life. They are either huge, very bright but relatively cool (giants and supergiants); or tiny, hot stars (white dwarfs) only about the size of Earth.

NASA,ESA, M. Robberto (Space Telescope Science Institute/ESA) and the Hubble Space Telescope Orion Treasury Project Team

G02_02 - 77.5625" x 58.5625"

Large Duratran Backlit Panel

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Project:
MUSEUM of the SOUTHWEST
BLAKEMORE PLANETARIUM

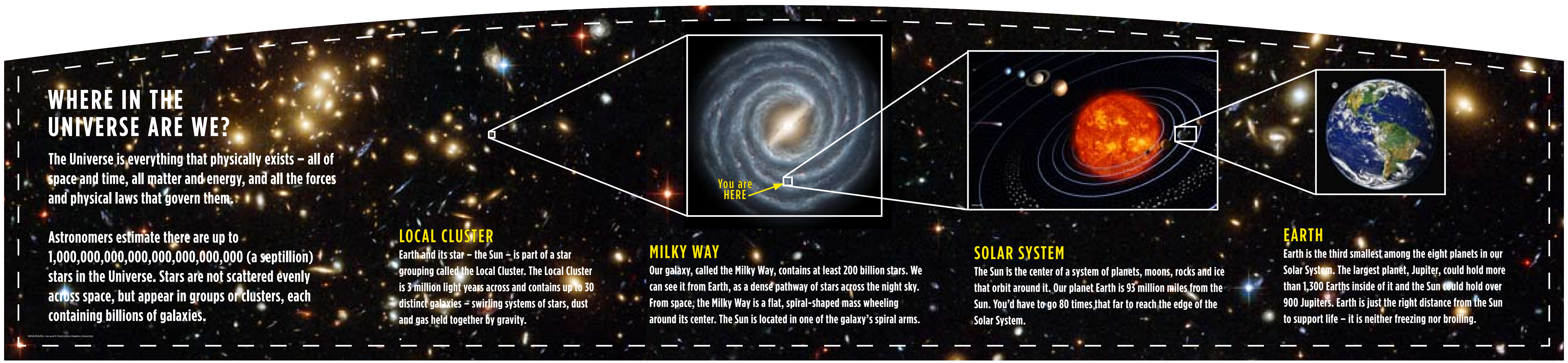
Phase:
Final Design

Date:
7/31/09

Drawing:
G02-01
G02

1

white dotted line denotes viewable area



G02-03 - 80" Backlit Reader Rail

Duratran Backlit Reader Rail

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7/31/09

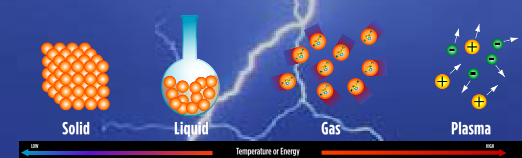
Drawing:
G02-03

white dotted line denotes viewable area

WHAT IS PLASMA?

STARS ARE MADE OF PLASMA

We live on Earth among solids, liquids and gases – the ordinary types of matter. But *plasma* – a fourth state of matter – makes up 99% of the universe. For example, stars are massive balls of plasma held together by gravity. Plasmas occupy interstellar space and stream toward our planet as solar wind.



Plasma is made up of free-floating charged particles resulting from the breakdown of gas atoms. The high heat of stars like our Sun can create this process. Plasma glows brightly and it also responds to electrical and magnetic forces.

It's generally too cold on Earth for naturally occurring plasmas. But plasma is well known to us – in the form of lightning and the northern lights. We also can create the conditions to produce plasma, for example, inside neon and fluorescent light tubes and in televisions.

Lightning occurs when massive electrical charges break down the gases in the atmosphere, creating plasma channels through which electricity can flow. The air in these channels is heated to over 50,000° F in only a few millionths of a second.

G02-05 - 38 x 76

Contour-cut Lambda Print

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G02-05

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STAR STUFF

G3-01 - Dimensional Title - 3″ letter height

We are made of star stuff.
-Carl Sagan

Almost all the materials that make up Earth – and our own bodies – were formed in the interiors of stars that died and exploded billions of years ago. Space is the ultimate Recycling Bin.

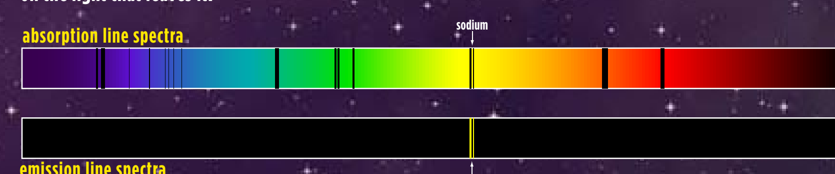
Stars contain mostly hydrogen and helium. But the nuclear fusion inside of stars also produces heavier elements such as nitrogen, oxygen, calcium, iron, gold and carbon. Stars that exploded long ago spewed these materials – known as star dust – into space. Here they formed into new stars, some of which eventually explode and produce more star dust.

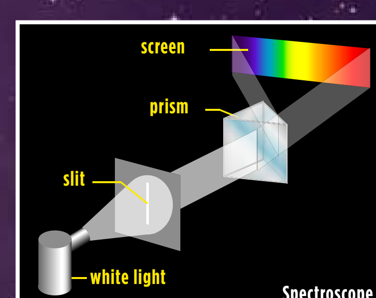
Our own Sun, the Earth and the other planets of our solar system formed out of this material about 4.6 billion years ago.

HOW DO WE KNOW WHAT STARS ARE MADE OF?

Light tells us. Scientists use spectroscopes *to read the light emitted by the stars.*

Visible “white” light, including star light, is made up of a rainbow of different colors, or wavelengths. Different gases or chemicals give off different light spectra. Each gas has a distinct signature of *spectral lines*, as unique as the fingerprints of a person. Gases in a star’s atmosphere leave their own fingerprint on the light that leaves it.





A spectroscope breaks down the light from a star (or other celestial body) into a very detailed spectrum. By closely examining the spectrum, astronomers can detect the different fingerprints and uncover the chemical make-up of the star.

Reading star light has provided a goldmine of information: what stars are made of and in what proportions, how hot a star is, and even how fast it is moving.

← A spectroscope uses a series of prisms or a *diffraction grating* to split starlight into its component wavelengths. The spectrum is then recorded onto a computer using a stream of digital signals.

G03-02 - 65.5 x 59.5625

PANEL APPROVED FROM PACKAGE DATED 7-24-09

Large Duratran Backlit Panel

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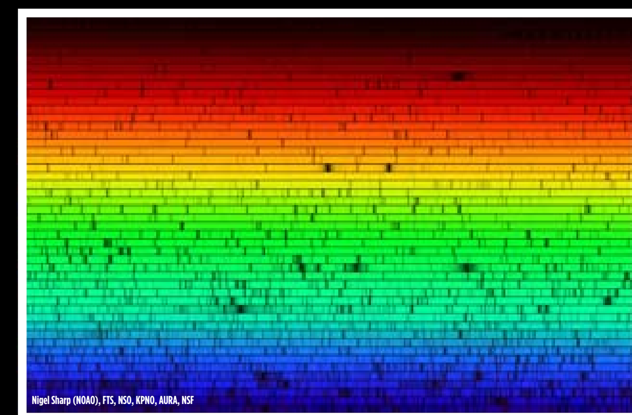
Drawing:
G03-01
G03-02

STUDY THE COLORS OF GASES

Each of the tubes contains a different gas. Notice the different colors each emits when it is lit up.

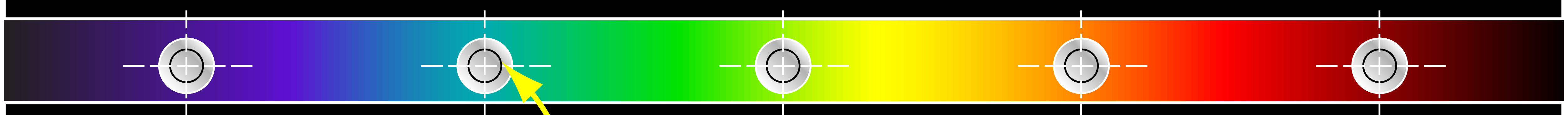
When a gas is excited by an electric current, it glows with a unique combination of colors, or spectra. No two gases will make the same pattern of colors.



Examination of the spectra produced by starlight, including that of our Sun (above), can reveal the gas make-up of distant bodies.

When you look directly at a glowing tube, the light you see is the combination of all the colors produced by that gas. Looking through the viewer or on the reflecting surface of the table, you'll see that gas's color spread out into its component colors.

Press the buttons below and look through the viewer at the gas filled tubes. Notice how the line patterns change for each gas.



ARGON | NEON | NITROGEN | HELIUM | XENON

.75" Stainless Steel Pushbuttons

G3-03 - 24 x 9

Phenolic Instruction Panel with Pushbuttons

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BLAKEMORE PLANETARIUM

Phase:
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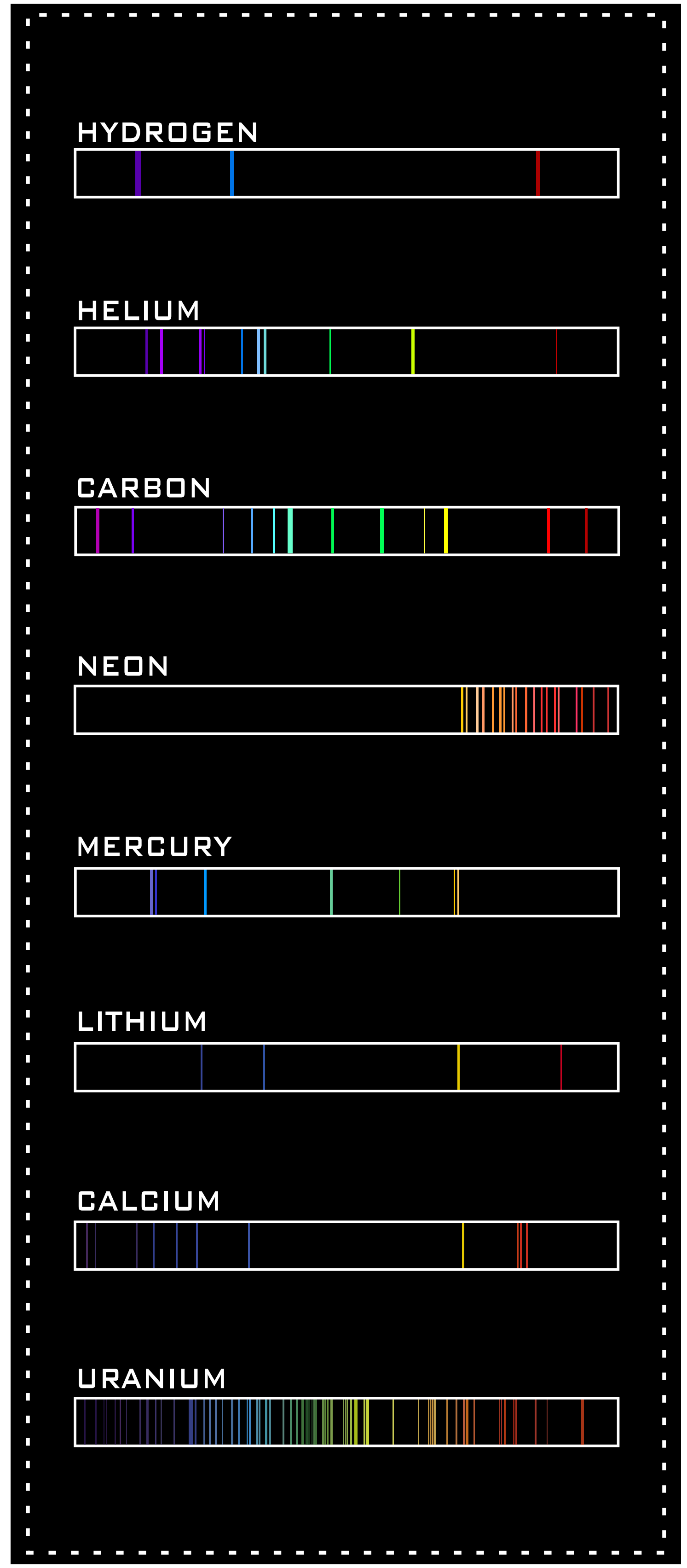
Date:
7/31/09

Drawing:
G03-03

white dotted line denotes viewable area



G03-05 - 14.875 x 34.625

Interactive Column Duratran

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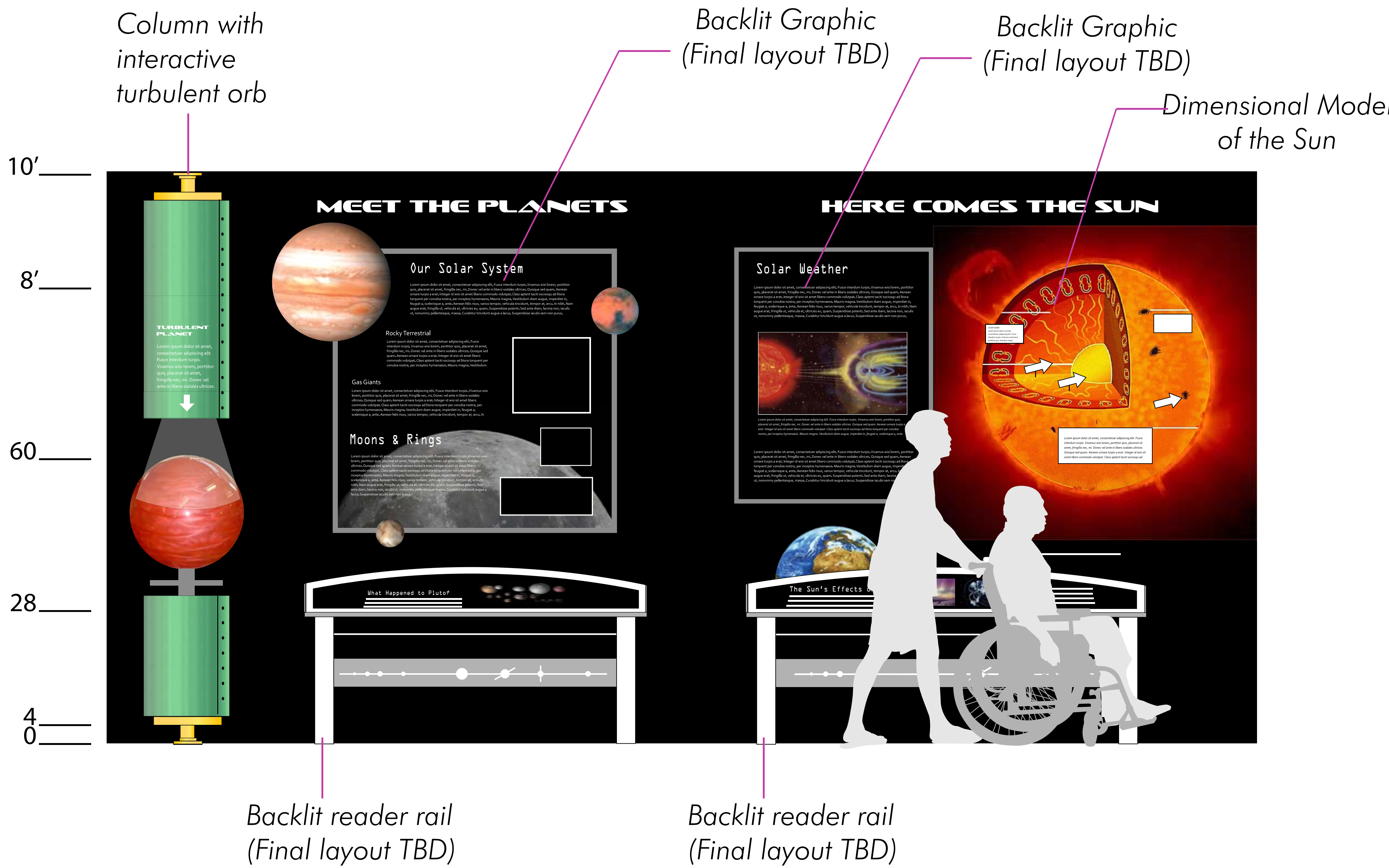
G03-05



Exhibits 4 & 5 - Here Comes the Sun and Meet the Planets

malone design/fabrication

Project:

MUSEUM of the SOUTHWEST

BLAKEMORE PLANETARIUM

Date:

May 6th, 2009

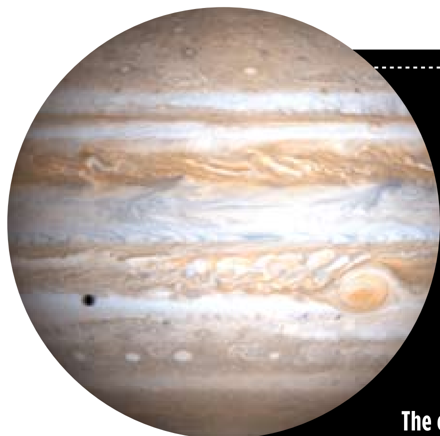
Drawing:

Exhibits 4 & 5
Color Elevation

white dotted line denotes viewable area

MEET THE PLANETS

G05-01 - Dimensional Title - 3" letter height



G05-05
18.5D

THE SOLAR SYSTEM

Eight planets, over 140 moons, and vast bands of drifting rocks and ice circle around a massive Sun to make up our Solar System. Born from the inward collapse of gases and dust about 4.6 billion years ago, the elements of our Solar System form an ever-revolving disk held together by the forces of gravity.

The eight planets of our Solar System are, by definition, bodies large enough to squash themselves into round balls through their own gravity. But there are two types of planets.

THE OUTER PLANETS ARE GASEOUS

The massive planets beyond Mars are sometimes called gas giants. Jupiter, Saturn, Uranus and Neptune are so large that altogether they make up 99% percent of the mass (material) orbiting the Sun.

Jupiter and Saturn are composed primarily of hydrogen and helium gases. Uranus and Neptune have a lot of ice in their make-up, along with ammonia and methane. All the gas giants have rings like the familiar ones of Saturn.

THE INNER PLANETS ARE ROCKY AND DENSE

Earth and its closest neighbors—Mercury, Venus, and Mars—are the smallest planets and nearest to the Sun. Also called the "terrestrial" planets, they have solid surfaces, are relatively dense and are made up mostly of rock and metal.

The rocky planets have relatively few moons and none have rings. Their surfaces are often marked with canyons, craters, mountains and volcanoes.

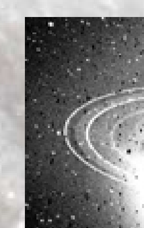
Olympus Mons on Mars is the tallest known volcano and mountain in the Solar System, towering 27 kilometers above the surrounding plains, and covering a total area of 550 kilometers across.

Just as a comparison, the tallest volcano on Earth is Mauna Kea; Olympus Mons is 2.6 times as large. And it's three times taller than Mount Everest above sea level.

MOONS AND RINGS

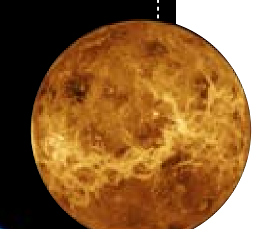
While the planets orbit the Sun, most also have natural satellites in orbit around them (called moons) or rings. Altogether the planets have at least 144 moons, including our own. Jupiter alone has 62 known moons, while Saturn has 61.

Saturn has the most spectacular rings. But astronomers have recently discovered rings encircling all the gaseous planets. Made up of ice and dust, they may have formed out of debris from a shattered moon, or from material that never came together as an actual moon.



Neptune's Rings

Saturn's Moon, Titan



G05-06
9.5D

G05-02 - 59.5625 x 59.5625

PANEL APPROVED FROM PACKAGE DATED 7-24-09

Large Duratran Backlit Panel, with Cut Out on 1/2" MDF Planet Graphics

malone design/fabrication

Project:
MUSEUM of the SOUTHWEST
BLAKEMORE PLANETARIUM

Phase:
Final Design

Date:
7/31/09

Drawing:
G05-02

white dotted line denotes viewable area

PLUTO: WHEN IS A PLANET NOT A PLANET?

Until 2006, scientists included a ninth planet in our Solar System, called Pluto. It lay at the very edge of the Solar System, so far away it was not discovered until 1930. A few years ago, astronomers placed Pluto in a new class of planets called dwarf-planets. Some scientists are still debating this change.

Pluto is tiny – smaller even than our Moon. It is an ice-body whose odd behavior had sometimes challenged astronomer's understanding. Since Pluto was reclassified, at least six other bodies have been placed in the same category.

Here is how dwarf-planets compare to the eight other planets, according to the International Astronomical Union's new definitions:

A PLANET...	A DWARF-PLANET...
Is in orbit around the Sun.	SAME
Is a body large enough to pull itself into a roughly spherical shape through its own gravity.	SAME
Has cleared the neighborhood around its orbit, that is, there are no other bodies in its path that it must sweep up as it goes.	Has not cleared the neighborhood around its orbit, but may travel with asteroids or ice bodies, such as those in the Kuiper Belt.

G05-03 - 68" Backlit Reader Rail

PANEL APPROVED FROM PACKAGE DATED 7-24-09

Duratran Backlit Reader Rail

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BLAKEMORE PLANETARIUM

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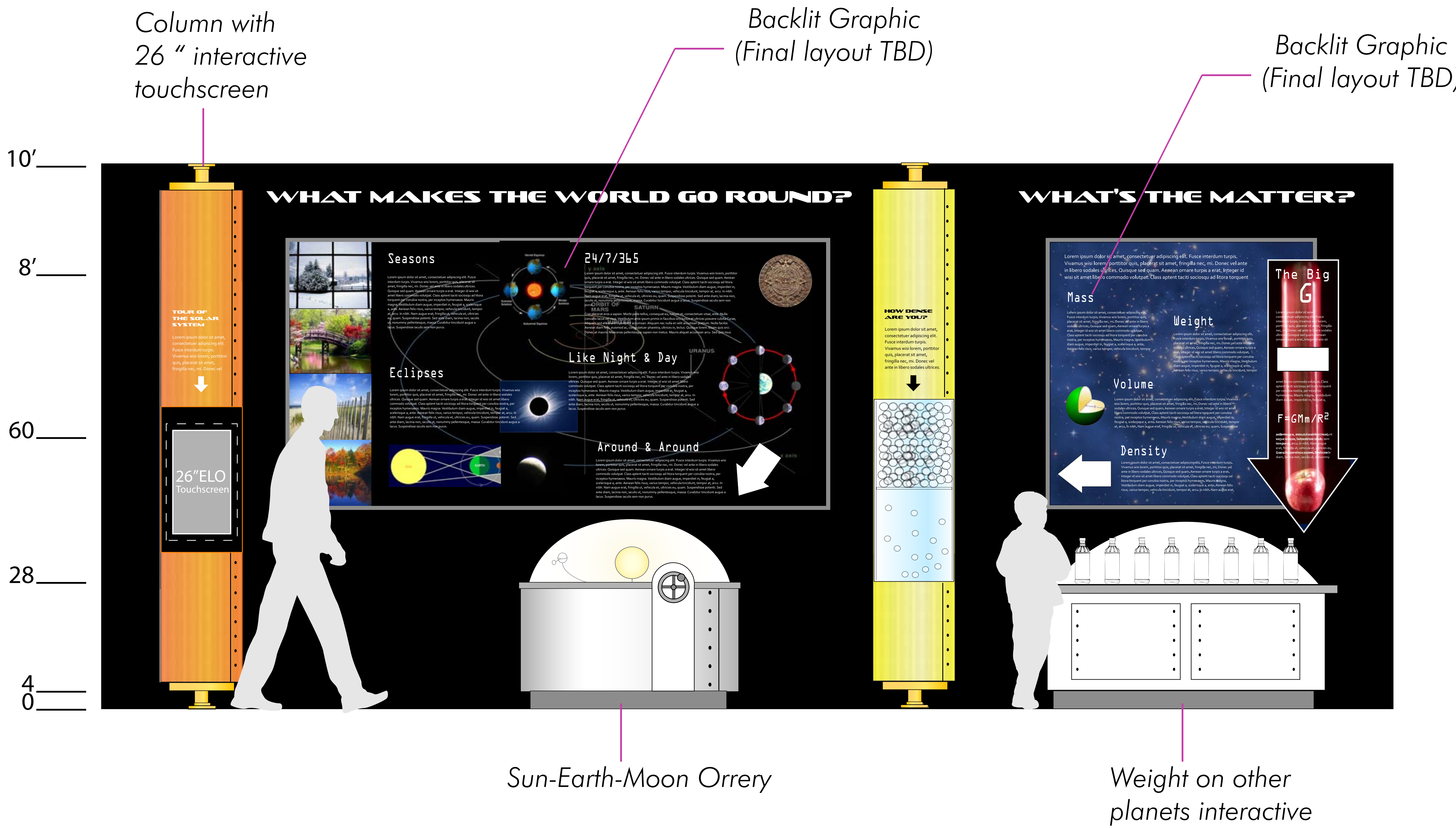
G05-03



Exhibits 6, 7 & 8 - What's the Matter, ...World Go Round and Tour of the Solar System

malone design/fabrication

Project:

MUSEUM of the SOUTHWEST

BLAKEMORE PLANETARIUM

Date:

May 6th, 2009

Drawing:

Exhibits 6, 7 & 8
Color Elevation

white dotted line denotes viewable area

WHAT'S THE MATTER

G06-01 - Dimensional Title - 3" letter height

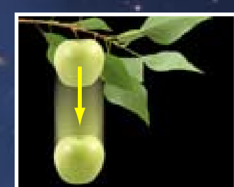
A MATTER OF FACT

Understanding matter and gravity can help us understand the entire universe. Matter is anything that occupies space – from the tiniest speck to an entire galaxy. Gravity acts on matter of any size, even across incredibly long distances.

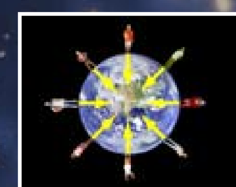
On Earth, we describe the force of gravity as the weight of an object. If you weigh 90 pounds, that is how much gravitational force the Earth is exerting upon you.

The Big G

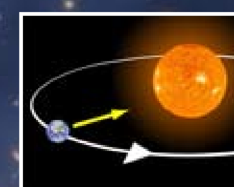
Gravity is the force of attraction that acts between any two objects. Because of gravity...



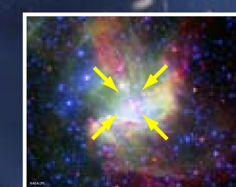
...a falling apple lands on the ground.



...people stay on the Earth and don't drift into space.



...the Earth revolves around the Sun .



...gases come together to form stars.

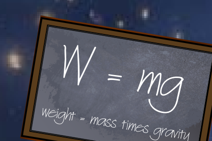
TALKIN' 'BOUT THE UNIVERSE

In order to calculate the force of gravity acting between objects in space, we describe the objects using the concepts of mass, weight *and* density.

MASS

Mass is a measure of the amount of matter an object contains. Most people measure mass in kilograms (kg.)

Mass is related to weight, but it not the same thing. The mass of an object stays the same, no matter where it's located in the universe. Weight changes depending on the pull of gravity where the object is located.



WEIGHT

Weight is a measure of the force of gravity pulling an object down. In everyday life, we measure weight by standing on a scale. Astronomers calculate the weight of much larger objects using units called *Newtons* (N).

Earth's gravity exerts a force of about 10 Newtons on an object that is 1 kg in mass (10N/kg). The planet Mercury exerts a smaller gravitational force of about .38N/kg, because Mercury is much smaller. So a person on Mercury would weigh less than that same person on Earth. But the person's mass would be the same on both planets.

These two objects may have the same volume, but the deck of cards has more mass and density than the sponge.

DENSITY

Density measures the compactness of the matter an object is made of within a unit of space, or *volume*.

Objects which are the same size and shape can vary greatly in mass because they vary in density. For example, a sponge that is the same size as a pack of cards is much lighter than the pack of cards, because the sponge has more air in its structure.

G06-02 - 59.5625 x 59.5625

USING THE FORCE

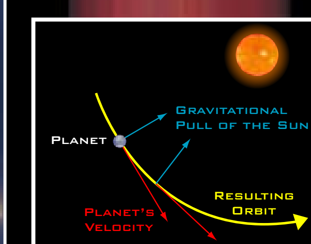
Another way to describe gravity:

$$F=GMm/r^2$$

In simpler terms, this equation (Newton's Theory of Gravitation) says:

- The power of the attraction between two objects depends upon the mass of the objects
- Increasing the distance between them reduces the force between them

The larger the object, the more gravitational force it exerts. An enormous body such as the Sun exerts a tremendous amount of gravitational pull on the planet Earth.



The Sun's inward pull of gravity on a planet competes with the planet's tendency to continue moving in a straight line. This unending tug-of-war between the Sun's gravity and the planet's inertia results in a stable orbit.

G06-03 - 24 x 60

Large Duratran Backlit Panel, with Cut Out on 1/2" MDF Arrow Graphic

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MUSEUM of the SOUTHWEST

BLAKEMORE PLANETARIUM

Phase:

Final Design

Date:

7/31/09

Drawing:

G06-01
G06-02
G06-03

10

white dotted line denotes viewable area

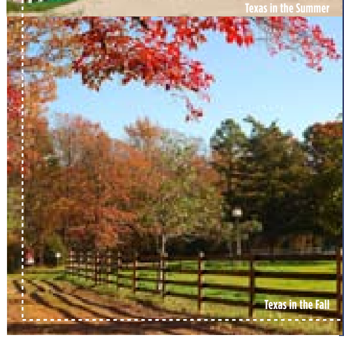
AROUND AND AROUND

G07-01 - Dimensional Title - 3" letter height


Texas in the Winter


Texas in the Spring


Texas in the Summer


Texas in the Fall

EVERYTHING GOES ROUND AND ROUND

Sun, moons and planets are in constant motion. Each one *rotates*, or spins, around its own axis (center). And each *revolves*, or moves in orbit around another body – the planets revolve around the Sun while the moons orbit their planets.

Days and nights, summer and winter, eclipses and phases of the moon – all are the result of the constant motion of the Sun, the Earth and our Moon.

WINTER, SPRING, SUMMER AND FALL

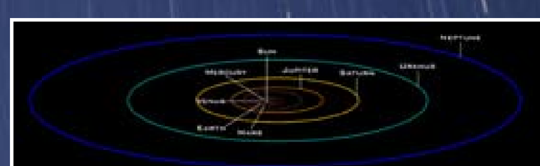
Earth orbits the Sun once a year – about every 365 days. We experience seasons because Earth's axis is tilted in relationship to the Sun, not straight up and down. Earth's axis always points in the same direction at about 23.6 degrees. As a result, different portions of the Earth's surface receive different amounts of sunlight at different times of the year.

When the north pole is tilted *toward* the Sun, it's summer in the northern hemisphere.

When the north pole is tilted *away* from the Sun, it's winter in the northern hemisphere.

WHY DOES IT ALL GO AROUND AND AROUND?

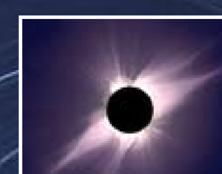
The mass of dust and gas that became our solar system was a swirling nebula with gravity at its center. The Sun and all of the planets, moons and other bodies that formed retain some of this original spin, or angular momentum. The mutual attraction of gravity between them keeps them in motion around one another.



NIGHT AND DAY

Earth rotates on its axis once every 24 hours. (Considering how fast it is going – about 1,000 mph or 1600 kph – that seems a long time!)

As Earth turns, the part that faces the Sun experiences daylight, and the part that faces away from the Sun is dark.


Total solar eclipse with Sun's corona


Total lunar eclipse in series

ECLIPSES

The word eclipse means the complete or partial blocking of one celestial body by another. From our view on Earth, eclipses occur when the Sun, Moon and Earth are all positioned in a straight line.

A solar eclipse is when the Moon passes between the Sun and Earth and casts a shadow on the Sun, temporarily darkening all or part of it. The Moon can eclipse the Sun totally or partially depending on a number of factors. Look at the diagram:

- People on Earth in the umbral part of the Moon's shadow will see the Sun totally darkened.
- People on Earth in the penumbral part of the shadow will see only part of the Sun darkened.

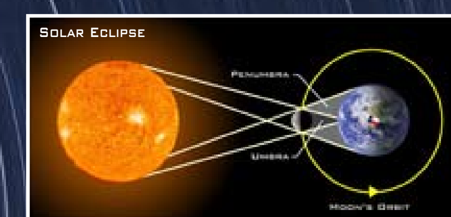
Lunar eclipses take place when the Earth passes between the Sun and the Moon. At those times, we see the shadow of the Earth on the Moon's surface.

FULL MOON, NEW MOON

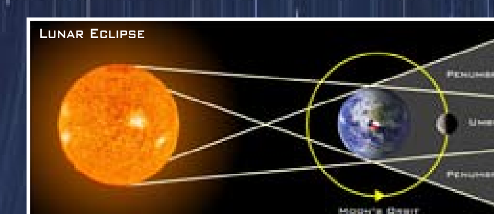
The Moon appears to be the brightest thing in our night sky. And it seems to change shape from day to day as it goes through phases from new moon to full moon and back again. Here's what's really happening:

- The Moon itself is dark and gives out NO light of its own. The only reason we see the Moon from Earth is because it reflects the light that the Sun shines on it.
- The Moon itself does not change. We see different phases of the Moon because the Moon is orbiting around the Earth at the same time that Earth and Moon orbit around the Sun.

The Moon travels in a full orbit around the Earth about once every 29.5 days. Half of the Moon is always in sunlight, but varying amounts of the lighted side can be seen from the Earth. In a dark new moon, the sunlit side faces away from the Earth. As Moon and Earth move along their orbits, more of the sunlit part is seen until it shines as a full Moon. Then less and less of the sunlit part is seen until the new moon returns.



Every time there is a total eclipse visible from one area of Earth, there are partial eclipses visible from other areas. Sometimes, depending on the exact location of the Moon, partial eclipses will be visible, but no area of Earth will see a total eclipse.



G07-02 - 119.5625 x 59.5625

Large Duratran Backlit Panel

malone design/fabrication

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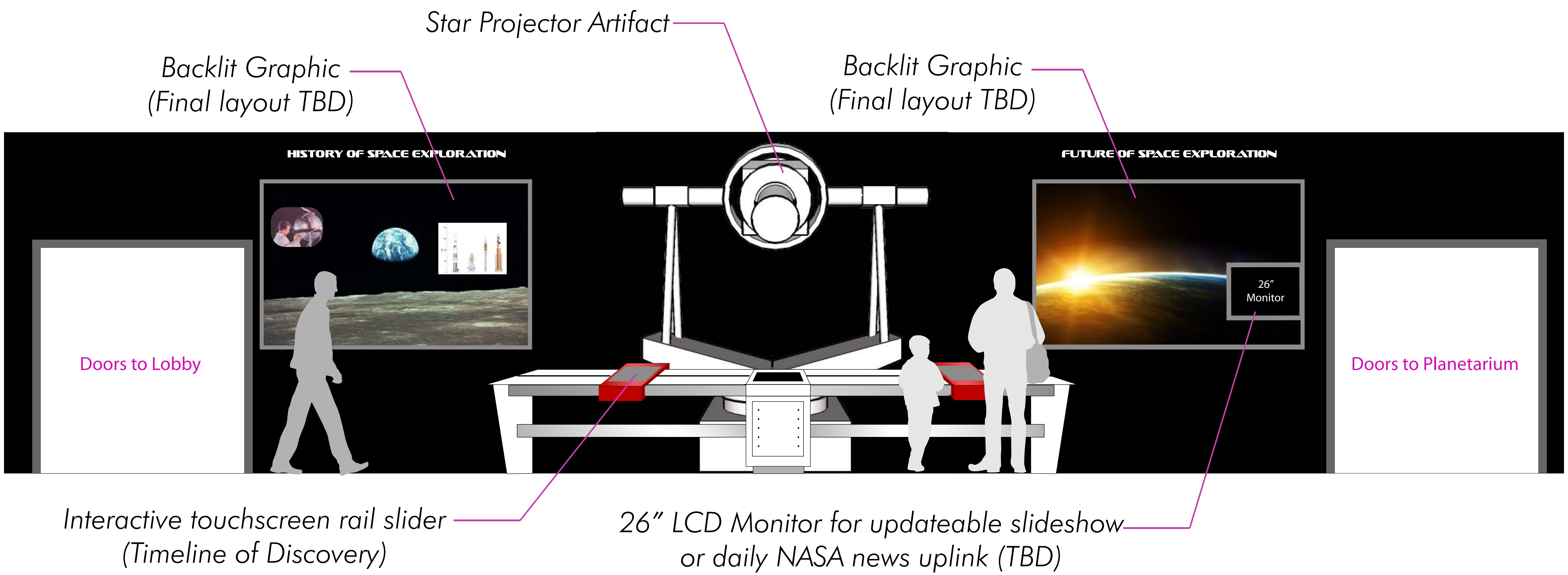
MUSEUM of the SOUTHWEST
BLAKEMORE PLANETARIUM

Phase:
Final Design

Date:
7/31/09

Drawing:
G07-01
G07-02



Exhibits 9 & 10 - Timeline of Discovery and Space Exploration

malone
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Project:

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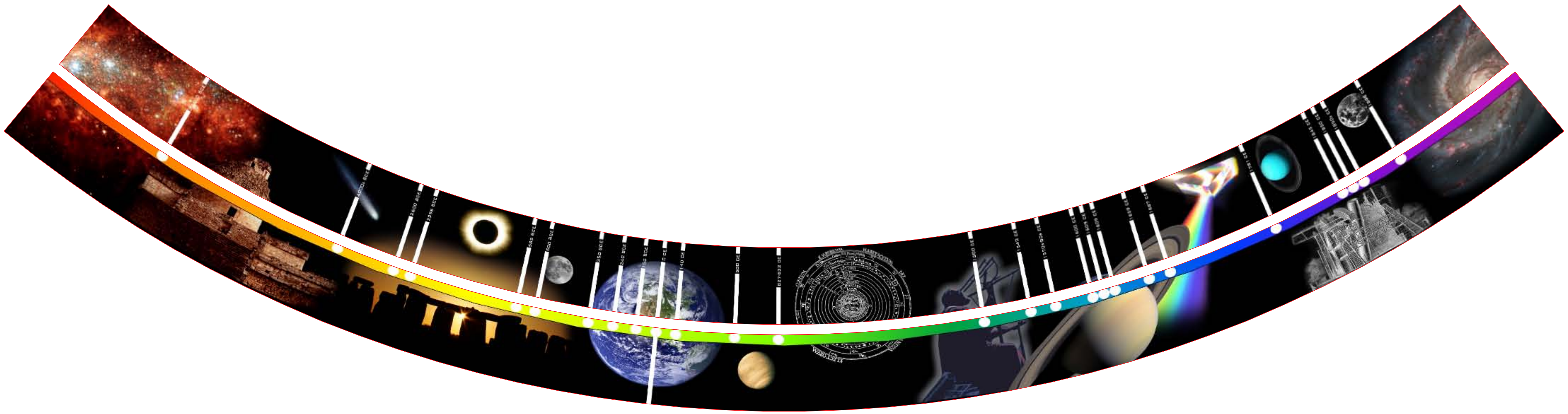
BLAKEMORE PLANETARIUM

Date:

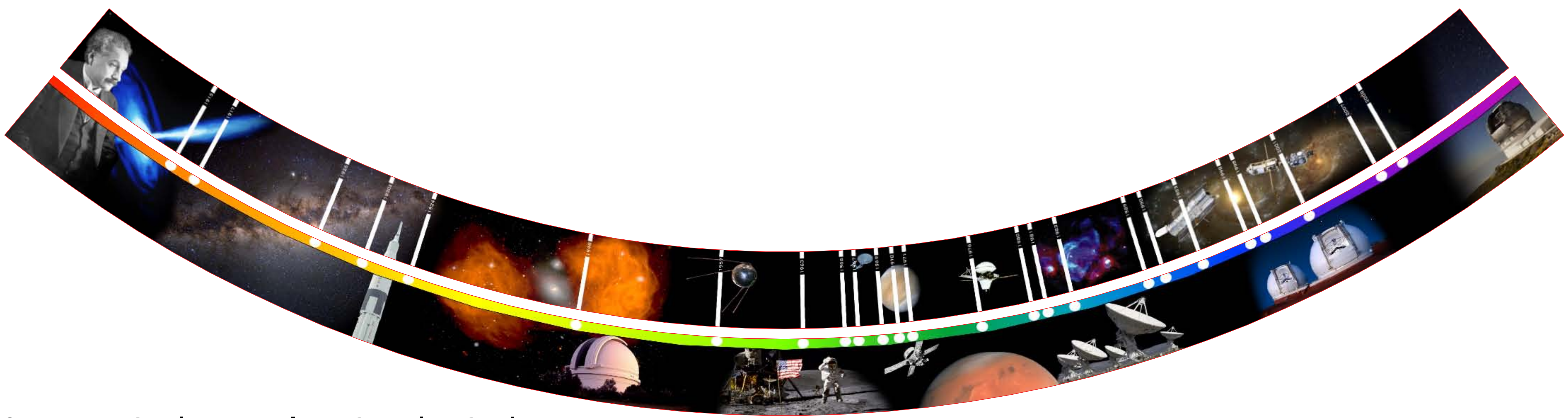
May 6th, 2009

Drawing:

Exhibits 9 & 10
Color Elevation



G09-01 - Left Timeline Reader Rail



G09-02 - Right Timeline Reader Rail

THE HISTORY OF SPACE EXPLORATION

Sputnik 1

For thousands of years, people have looked with wonder and curiosity to the heavens. Early astronomers used observation and measurement, mathematics and telescopes to create a remarkably sound picture of the cosmos.

When people finally gained the technology to escape Earth's gravity and launch equipment— and then themselves—into space, the Age of Space Exploration began.

LEAVING EARTH IS ROCKET SCIENCE!

Apollo 11 Saturn V liftoff

Visiting space requires the power to lift a heavy spacecraft off the ground and then to quickly create the speed to move beyond Earth's gravity. Before space travel could take place, exhaust-propelled rockets had to be perfected.

The Chinese developed the first rockets in the 1500s to propel military weapons and fireworks, but the modern technology did not emerge until the 20th century. In 1926, American Robert Goddard launched the world's first liquid-fueled rocket. His research laid the groundwork for German, Soviet and American scientists to develop rocket-propelled space vehicles.

Burning rocket fuel produces large amounts of very hot gases that are expelled through an exhaust nozzle at the bottom of the rocket. The force is enough to lift the vehicle off the ground.

A multi-stage rocket uses two or more stages, each of which carries its own engines and fuel. By discarding the stages as they run out of fuel, the spacecraft becomes lighter and the remaining stages can more easily propel the vehicle.

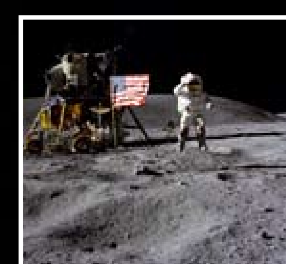
THE RACE FOR SPACE

During the 1950s and 1960s, competition between the United States and the Soviet Union fueled the rapid development of space exploration. The two countries battled to be the first to put a satellite, and then a person, into space; to have the first astronaut in orbit; to take the first spacewalk; and to be the first on the Moon.

In October of 1957, the Soviets stunned American scientists by launching the first artificial satellite—*Sputnik 1*—into orbit around the Earth. Four months later, the United States successfully launched its own satellite, *Explorer 1*.

In 1961, Yuri Gagarin of the Soviet Union became the first human being to orbit the Earth. The United States followed in 1962 when John Glenn Jr. orbited the Earth in the *Friendship 7* capsule.

MAN ON THE MOON



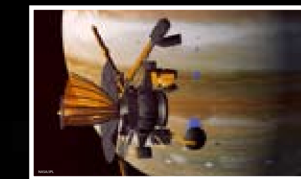
Millions of people watched on television as astronaut Neil A. Armstrong stepped onto the Moon's surface and said, "That's one small step for a man, one giant leap for mankind."

"Houston, Tranquility Base here. The *Eagle* has landed." So American astronaut Neil A. Armstrong announced the landing of the first manned spacecraft on the Moon on July 20, 1969.

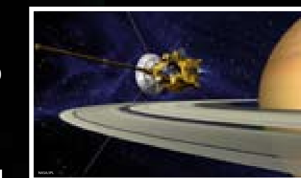
The Apollo missions that led to the first moon landing began in 1967. The successful Apollo 11 was launched by a three-stage Saturn V rocket, still one of the largest and most powerful launch vehicles ever operated.

UNMANNED SPACE PROBES

In the late 1950s and 1960s, Americans began sending unmanned satellites into space for surveillance and navigation – and to journey to other planets. The first human-made object reached another planet in 1962, when *Mariner 2* passed within 22,000 miles of Venus. Unmanned space probes continue to be critically important to space exploration.



Galileo (above) and *Cassini-Huygens* (below)



Space shuttles such as *Columbia*, *Atlantis*, and *Endeavor* have flown a total of over 120 manned missions into space. Astronauts launch or retrieve satellites, repair equipment or carry out research. The Shuttles also provide transportation to the space stations.

SPACE SHUTTLES – REGULAR VISITORS TO SPACE

Before 1981 when the first space shuttle was launched, rockets were used once and jettisoned during the mission. Space shuttles were designed to be reusable – winged rocket planes that could fly multiple manned missions and land like an airplane on ordinary airfields. The more cost-effective space shuttles make regular space travel possible.

Night launch of the final lunar landing mission, Apollo 17, from Kennedy Space Center on December 17, 1972.

It took three days for Apollo 11 to reach orbit around the Moon. Then, Armstrong and Edwin F. Aldrin Jr. entered the Lunar Module to make the Moon-landing, while astronaut Michael Collin remained in orbit in the Command Module.

Between 1969 and 1972, twelve other astronauts walked on the moon in six separate Apollo missions.

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INTO THE FUTURE

The present and future of space exploration is an international endeavor. Dozens of countries pool knowledge and resources to continually expand our knowledge of the universe around us.

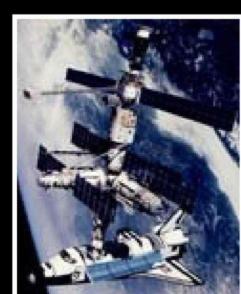
The video monitor to your right provides up-to-date information on current and planned NASA missions.

SPACE STATIONS: LIVING IN SPACE

Astronauts have lived for a few weeks to more than a year in space stations orbiting the Earth. Both Americans and Soviets operated space stations (*Salyut and Skylab*) throughout the 1970s. From 1986 to 1996, Russian space station Mir welcomed astronauts from many countries.

Starting in 1998, America, Russia and 14 other nations began working together to build the *International Space Station* (ISS). Portions of the station are being delivered piece by piece to the "building-site" 220 miles (354 km) above the Earth.

Skylab in Earth's orbit.



American space shuttle *Atlantis* joins with the Russian space platform, *Mir*.

The completed International Space Station will be 240 feet (73 m) long with a living area equal to the cabin size of two 747 jets. When completed in 2011, it will carry up to seven astronauts who will live and work there for three to six months at a time.

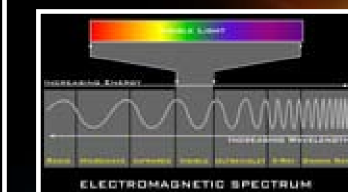
TELESCOPES: LOOKING INTO SPACE

Telescopes bring the vastness of the universe into closer view, allowing us to see and record planets, stars and galaxies at an astonishing level of detail. They collect data from light in the visible spectrum as well as X-ray, infrared, ultraviolet, microwave and radio wavelengths, including detecting phenomena that we can't see at all with the naked eye.

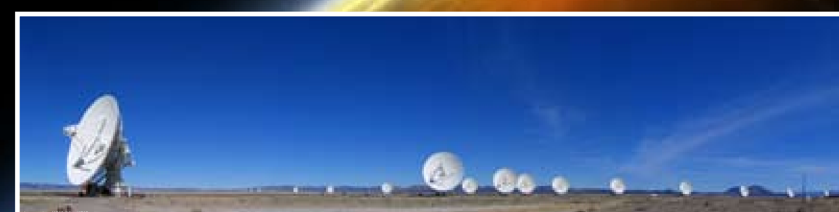
Most optical research telescopes are reflective, using mirrors to reflect and focus visible light and make distant objects appear much closer and therefore larger. Increasingly larger mirrors or honeycombs of mirrors have expanded the reach of optical telescopes to distant galaxies and nebulae.

← Saturn viewed at different wavelengths.

Gran Telescopio Canarias



Radio telescopes collect information transmitted by radio waves, which have the longest wavelengths of the electromagnetic spectrum.

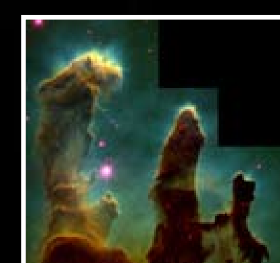


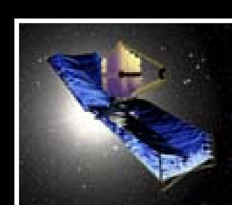
Clusters of telescopes, like the Very Large Array in AZ (above), connected by computers can capture and integrate ever more detailed images from space.

SPACE TELESCOPES

Positioned beyond Earth's atmosphere, space telescopes record very high quality images and can also detect electromagnetic wavelengths not visible on Earth.

The Hubble Space Telescope was carried into orbit in 1990, 347 miles (559 km) above the Earth. Peering far into the cosmos, it has documented thousands of new galaxies and produced some of the most astonishing and beautiful images we have of space.

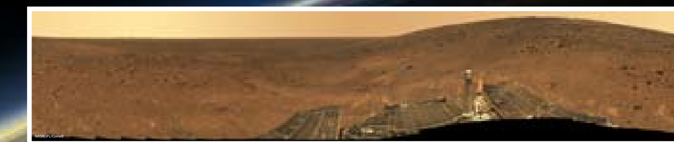




The Hubble's successor, the James Webb (Next Generation) telescope, will carry a mirror ten times bigger than Hubble's. It will be tuned for infrared wavelengths, enabling it to find the oldest galaxies and look inside dust clouds where stars are forming.

LANDERS AND DISCOVERS

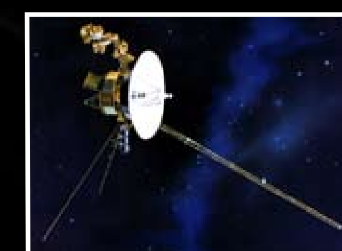
Unmanned satellites and probes journey into space to collect information impossible to get in any other way. Probes have visited all the planets in our Solar System, as well as the moons and asteroid belts.



"Independence" panorama of Mars, taken by the *Spirit* Rover.

Mars Exploration Rover

The *Exploration Rovers* have landed on Mars, documenting its surface and providing evidence for liquid water in times past.



Voyager 2, launched in 1977, reached Uranus and Neptune and is now traveling beyond the Solar System, carrying images and sounds from Earth.

The *New Horizons* robotic probe is headed for the dwarf planet Pluto and then will explore the Kuiper Belt, the band of ice and rock that forms the outer edge of our solar system.

Notch for Slideshow Moniter

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