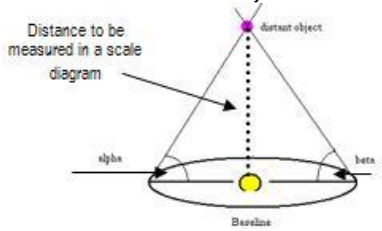
Measuring Distance in Space

Triangulation and Parallax are two ways to measure distances indirectly, on the ground, or in space.

Triangulation - is based on the geometry of a triangle. By measuring the angles between the baseline and a target object, you can determine the distance to that object.
To measure the distance indirectly, you need to know the length of one side of the triangle (baseline) and the size of the angles created when imaginary lines are drawn from the ends of the baseline to the object.



Parallax

Parallax is the apparent shift in position of a nearby object when the object is viewed from two different places. Astronomers use a star's parallax to determine what angles to use when they triangulate the star's distance from the Earth. The larger the baseline, the more accurate the result. The longest baseline that astronomers can use is the diameter of Earth's orbit. Measurements have to be taken six months apart to achieve the diameter of the orbit.

A Star's Composition

Astronomers refract the light from distant stars to determine what the star is made of. Stars have dark bands in distinct sequences and thicknesses on their spectra. Each element that is present in the star creates its own black-line 'fingerprint'. The spectra of the star are then compared to known spectra of elements to determine the star's composition. A spectrometer is used to do this.

Direction of Movement

A change in the pitch (frequency) of sound waves because they are stretched or squeezed is known as the **Doppler Effect.** Changes in the sound waves can be measured to determine how fast and in what direction a light-emitting object is moving. The position of the dark bands is what shifts in the light waves of a moving star. The spectrum of an approaching star shows the dark bands shifting to the blue end of the spectrum, whereas, the shift is to the red part of the spectrum if a star is moving away from the Earth. The amount of shift indicates the speed at which the star is approaching or moving away. There are also practical applications that use the Doppler Effect. Law enforcement officers detect the speed of an approaching vehicle by using a **radar gun**. To determine the speed of the vehicle, the hand-held device records the difference in the outgoing and incoming sonar wavelength.

Dangers of Space Exploration

The dangers of the '*unfriendly* space environment include: accidents that may result in loss of life, economic setbacks and many years of work.

There are tragedies that bring to life the true dangers of space travel, such as:

1967

3 astronauts of **Apollo 1** died during a training exercise

1986

7 astronauts died when the **Space Shuttle Challenger** exploded shortly after launch

2003

7 astronauts died when the **Space Shuttle Columbia** broke apart during re-entry

A **launch** can be affected by many dangers, including highly explosive fuel, poor weather, malfunctioning equipment, human error and even birds.

Once in flight, the spacecraft can be affected by floating debris, meteoroids and electromagnetic radiation (coronal mass ejections – or, solar flares).

Re-entering Earth's atmosphere also has it dangers (as proven by the Colombia disaster). The re-entry path the spacecraft takes must be perfect, otherwise, if it is too shallow - it will bounce off the atmosphere, and if it is too steep – it will burn-up.

Space junk refers to all the pieces of debris that have fallen off rockets, satellites, space shuttles and space stations that remain in space. This can include specks of paint, screws, bolts, nonworking satellites, antennas, tools and equipment that is discarded or lost.

Hazards in Space

Micrometeorites are constantly bombarding spacecraft and the International Space Station. They travel at extremely high velocity and can cause great damage. Once they enter the atmosphere, they usually burn up.

Hazards on Earth

Some debris in space will enter the atmosphere and will not totally burn up. When this occurs, it may land in populated areas and cause loss of life or damage to property. Some satellites, or decommissioned space stations, that re-enter the atmosphere have radioactive parts and can contaminate a very large area, costing a lot of money and hours to clean it up. Some burn up in the atmosphere and those parts that don't, can fall into the ocean, making recovery and clean-up less costly.

Pros and Cons of Space Exploration

Disease, poverty, hunger, pollution and terrorism are all problems that face the people of the Earth. Spending billions to explore space, or spending billions to solve the conditions we currently experience is an ongoing debate that likely will never be solved. With depleting natural resources, population increases and advances in technology, the exploration of space may be the only option in the future.
Resources in Space - mean economic wealth. Energy supplies appear to be unlimited – solar energy from the Sun and mineral resources from the Asteroid belt. The cost of travel in space could be cut substantially if fuel and construction material is readily available in space. The Moon is one of the first places scientists looked for resources where they were able to process hydrogen and oxygen from Moon rock. The oxygen could be used for life support and hydrogen for fuel on lunar bases. Combining the two, water can be produced.

Potential Space Issues

Political	Ethical	Environmental
Who owns space?	Is it right to spend so much on space, instead of fixing Earth's problems?	Who is responsible for protecting space environments from alteration?
Who can use the resources in space?	Do we have a right to alter materials in space to meet our needs?	Who is responsible for cleaning up space junk?
Who will determine what goes on in space?	How can we ensure that exploration will be used for good and not evil?	

Many countries have contributed to the **International Space Program**.

Explore the historical perspectives as well as examine what is currently happening and what is being planned for the future by visiting the following websites.

NASA
http://www.nasa.gov/

Canadian Space Agency
http://www.space.gc.ca

European Space Agency
http://www.esa.int/esaCP/index.html

Asian Pacific Space CO
http://www.apsco.int/