



Name _____

Directions: Color pink any information below that describes the 3 kinds of Earth's orbits. Color blue any information below that describes the manmade objects found in each orbit.

Satellites and Orbits

October 4, 1957, Russia launched Sputnik and in February 1958, the U.S. sent its own Explorer 1 into space and they began the Space Race. Since then, humans have launched over 2500 satellites into Earth orbit. Among these satellites and other orbiters have been: The Hubble Space Telescope; The International Space Station (ISS); Russia's Mir Space Station; a 27 satellite GPS system as well as numerous communications, weather, broadcast TV and radio satellites. We have turned the space surrounding our Earth into a very busy place.

In order to keep all of these satellites in orbit and useful to us on the planet's surface, we need to understand a bit more about them. Different Earth orbits give satellites and other orbital bodies different perspectives and abilities to perform their jobs. Some orbits allow these objects to hover over a particular point of the Earth, others allow them to quickly circle the Earth and see many places. The purpose of the satellite or other orbital body is what determines which orbit type is best suited. The motion of the satellite is greatly controlled by the Earth's gravity. When things are closer to Earth, the pull of gravity is stronger and the object must move faster to counter that pull and stay in orbit. The farther away from Earth the object is, the slower it can move and still remain in orbit.

There are basically three types of Earth orbits that are used by Space Agencies and Satellites: a low Earth orbit, a medium Earth orbit and a high Earth orbit. Each of these orbit has advantages and disadvantages and reasons for use. Also, for each orbit, there is a speed needed that will balance gravity and centrifugal force.

Low Earth Orbits or LEOs begin just above the top of Earth's atmosphere and extends to a level 1200 km above Earth's surface. Objects orbiting at this level have to fight against the pull of Earth's gravity. In order to keep from being pulled back into Earth's atmosphere and being burned up, they have motion to keep them in orbit. In the LEO, an object needs to move at 28,100 km/hr (17,500mph) in order to maintain a stable orbit. Objects here are able to complete an orbit every 90 minutes or so. So, you may ask, what types of items might we expect to find in LEO?

LEO is usually used for things that we wish to be able to visit often or get to when repairs are needed with a Space shuttle. Some examples include the International Space Station, the Hubble Space Telescope, some communications satellites and Earth monitoring satellites. These are the types of things

that need to be updated, inspected for damage and fixed, on a recurring basis. Additionally, LEO is the only place where, at least currently, humans can get to easily to perform space experiments and return home in a relatively short period of time. Objects in LEO are orbiting at altitudes of 200-1200 km above Earth. At this level, radiation from space is at a lower level and the cost to put objects into orbit is lower than the other orbit choices.

The disadvantages of the LEO is it has become very congested over the past 55 years, there are greater risks of collisions and major damage to objects in this orbit layer and there is still an effect of atmospheric drag on objects in this orbit.

The next orbital layer is the Middle Earth Orbit, also called MEO. In this orbit, objects are 1200km-35790km above Earth's surface. Since they are further out, the drag effect from Earth's atmosphere is less, allowing these objects to travel at speeds of 11200 km/hr (7000mph). MEOs are also referred to as Highly Elliptical Orbits. These orbits are best suited for orbitals that cover the Polar Regions or where we wish to have continuous coverage of the entire Earth. Satellites at these heights take approximately 12 hours to complete an orbit and they spend most of their time in positions that are furthest out from Earth's surface. At this point, the satellite moves very slowly, while increasing speed at its closest point. In order to provide more extensive coverage, there needs to be multiple satellites focused upon the same area, but having different timing of orbits. When we look at GPS systems, there are often at least 3 satellites covering any location on Earth at any given time.

When a satellite or orbital reaches a point approximately 36,000km above the Earth, its orbit will tend to match Earth's orbit. These objects are said to be in Geosynchronous or Geostationary orbit (GEO). GEOs orbits take approximately 24 hours as the orbiter is moving at a speed of 1600km/hr (1000 mph). They are popular orbits for broadcasting and communications satellites like Direct TV and Cell phones or other relay systems. The advantage of this orbit is that the antennas on Earth do not have to change position to stay in contact with the satellites. The first GEO satellite launched was Syncon 2 in July of 1963. Many other GEO satellites have been launched in the last 50 years. This is also a perfect location to house weather satellites to cover Earth weather and study space weather, as well as provide telecommunications and TV signals.

The disadvantages of this orbit layer are the expense to put objects at that level and the fact that it will not be accessible from a shuttle to take care of any repairs that may be needed.

Space surrounding our Earth has become very congested over the past 55 years and will continue to do so as long as mankind wishes to learn more about our planet and the rest of the solar system. Our task now becomes to be aware of our needs and how we are impacting and modifying areas outside of our atmosphere.

Scoring Guide for Earth in Space Map

Name _____

Requirements	Points Possible	My Points	Comments
The 3 Earth's orbits are identified by 3 different colors and are labeled.	10		
The Earth's 3 orbits' distances from the Earth are identified and approximately correct.	20		
The estimated number of manmade objects is identified by dots for each of the 3 orbits	10		
At least 2 kinds of manmade objects are identified for each of the 3 orbits	20		
The map has a title	5		
The map has a legend with at least 5 symbols	20		
The map has a scale that fits with the distance estimated from the Earth.	10		
The map is neatly done	5		
Total Points	100		

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The map is neatly done	5		
Total Points	100		

T-chart Graphic Organizer

Name _____

Directions: As the videos play, identify and write down positive and negative consequences to having manmade objects in space. You should have at least 10 correct responses between the two columns.

Positive Consequences	Negative Consequences

Questions I still have:

Answer Key for T-chart Graphic Organizer

Positive Consequences:	Negative Consequences:
Communications, weather forecasts, and television	Orbit is getting extremely crowded
Earth's atmosphere keeps debris too close to minimum	At orbital speeds even the smallest items are incredibly dangerous
We can track debris using radar	Objects come very close to damaging satellites frequently
Earth's gravitational field can slow disperse of space junk.	Majority of collisions cannot be avoided always
Speed of trajectory keep debris in space often	Due to the extreme speed of the debris, when collisions occur it creates a large amount of more space debris
	If no actions are taken, space travel will become very dangerous.
	Possible radioactive debris, harm done to civilians
	Many contain deadly chemicals health hazards

Scoring Guide for Writing Assignment

Name _____

Requirements	Points Possible	My Points	Comments
Essay has a title.	5		
Essay has an introduction.	10		
Essay answers the question: Should we continue to add manmade objects to space?	10		
The answer to this question is supported with facts.	20		
Essay answers the question: How should we take care of useless equipment and avoid the "trash pile" that is growing in space?	10		
The answer to this question is supported with facts.	20		
Paragraphs are logically divided.	5		
Essay has a conclusion.	10		
Good grammar and spelling are present.	10		
Total Points	100		

Scoring Guide for Writing Assignment

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Essay has a title.	5		
Essay has an introduction.	10		
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The answer to this question is supported with facts.	20		
Essay answers the question: How should we take care of useless equipment and avoid the "trash pile" that is growing in space?	10		
The answer to this question is supported with facts.	20		
Paragraphs are logically divided.	5		
Essay has a conclusion.	10		
Good grammar and spelling are present.	10		
Total Points	100		