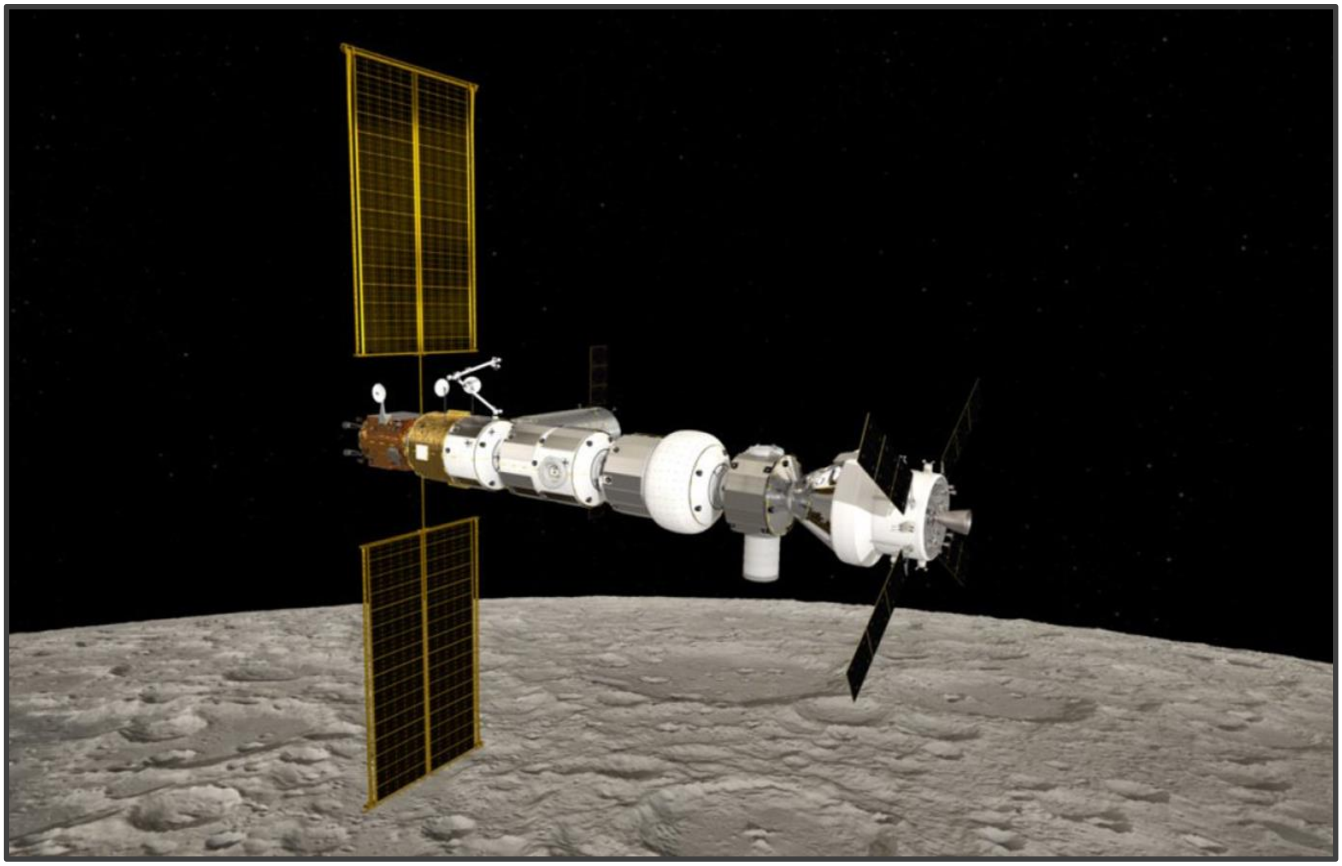
# Spacegate Station Academy
# Episode 6



## Gravity and Orbits

- Unit 1 Gravity
- Unit 2 Gravity in Space
- Unit 3 The Role of Gravity
- Unit 4 Maintaining an Orbit
- Burn Calculation Practice
- Answer Sheet
- State of Florida Standards

# Lesson 1 - Gravity and Orbits

Unit 1 Gravity

**Attraction** **Bigger** **Gravity** **Pulls** **Smaller**

1. Gravity is a force of ___________ between objects.
2. The atoms of one object ________ on the atoms of another object.
3. When one of the objects is _____________, then it pulls the___________ object towards it.
4. This pull is __________ at work.

How much do I weigh on the moon? ________________________

$$\text{weight on the Moon} = \frac{\rule{3cm}{0.4pt}}{9.81} \times 1.622$$

Unit 2 Gravity in Space

**Force** **Little** **Mass** **Weight**

5. In space, there is very __________ gravity.
6. This is because the distances between you and other large objects are so vast, the ________ is minimal.
7. You would still have _______, and because there is still a little bit of gravity, you would still have some _________.

Unit 3 The Role of Gravity

**Ellipse** **Falling** **Forces** **Gravitational** **Gravity** **Orbiting** **Propelled** **Velocity**

8. The space station is traveling or _______________ around the Moon.
9. There are two _________ involved that act on the space station to keep it in its orbit.
10. First, _________is pulling the space station back to the Moon, so technically, the space station is ___________ towards the Moon.
11. Second, the space station is being __________ forward and is moving at a constant speed.
12. This forward speed or ______________, combined with the fact that the Moon is also moving, keeps it from falling into the Moon.
13. Although the station misses the Moon, it is quickly pulled back by the Moon's ______________ attraction and begins to fall again.
14. The path of this special orbit is a curve, or ______________, which is the result of the combination of the two forces.

Unit 4 Maintaining an Orbit

**Boost  Desired  Distance  Present  Slow  Vacuum  Velocity**

15. Space is not a perfect _____________, there is a thin layer of dust, dirt and gas particles that surrounds the Moon.
16. Over long periods of time, the effect of the particles colliding with the space station are significant enough to _________________ down the space station's orbit.
17. To remain in orbit, occasionally, the station needs to ____________ its orbit back to where it should be by using its onboard thrusters.
18. To calculate how much thrust is needed, four pieces of information are required:

    a. The ____________ location of the station in relation to the lunar surface

    b. The ___________ location of the station in relation to the lunar surface

    c. The ____________ from the present location to the desired location

    d. The present orbital __________ of the station*.

## Orbit Calculations

To change the orbit of the station it is necessary to determine the following information to calculate the amount of time in seconds the Engines need to operate or burn (must be rounded to the nearest whole number):

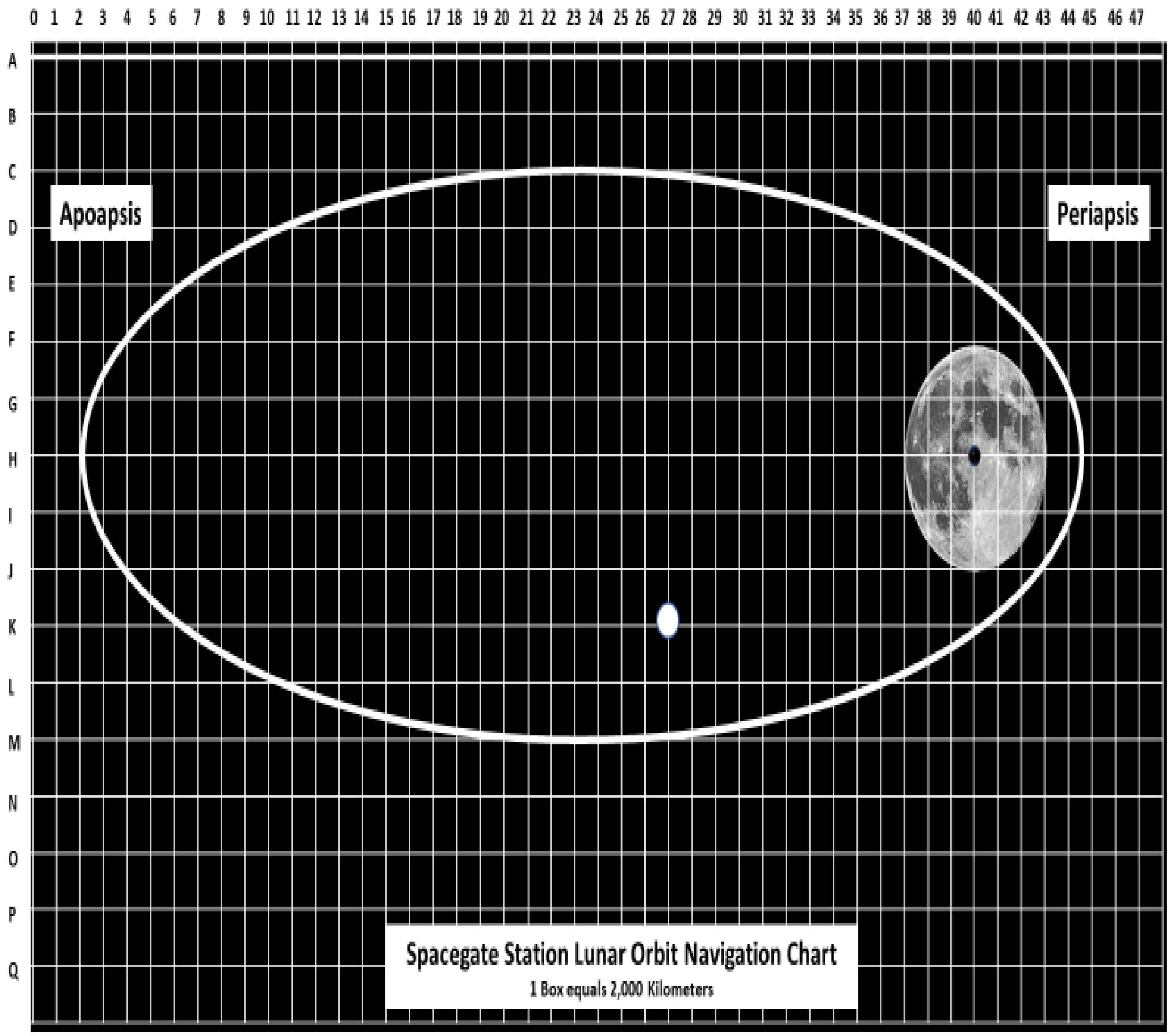
1. The present location of the Station on the Lunar Orbit Navigation Chart.
2. The desired location of the station on the Lunar Orbit navigation Chart.
3. The distance from the present location to the desired location.
4. The present orbital velocity of the space station*

$$\frac{\textbf{Burn time (in seconds)}}{\textbf{1}} = \frac{\textbf{Distance to Location}}{\textbf{Orbital Velocity}}$$

*This information is supplied by NASA from the Deep Space Network.

# EXAMPLE

Determine the burn time based on the information provided by the Navigation Chart.

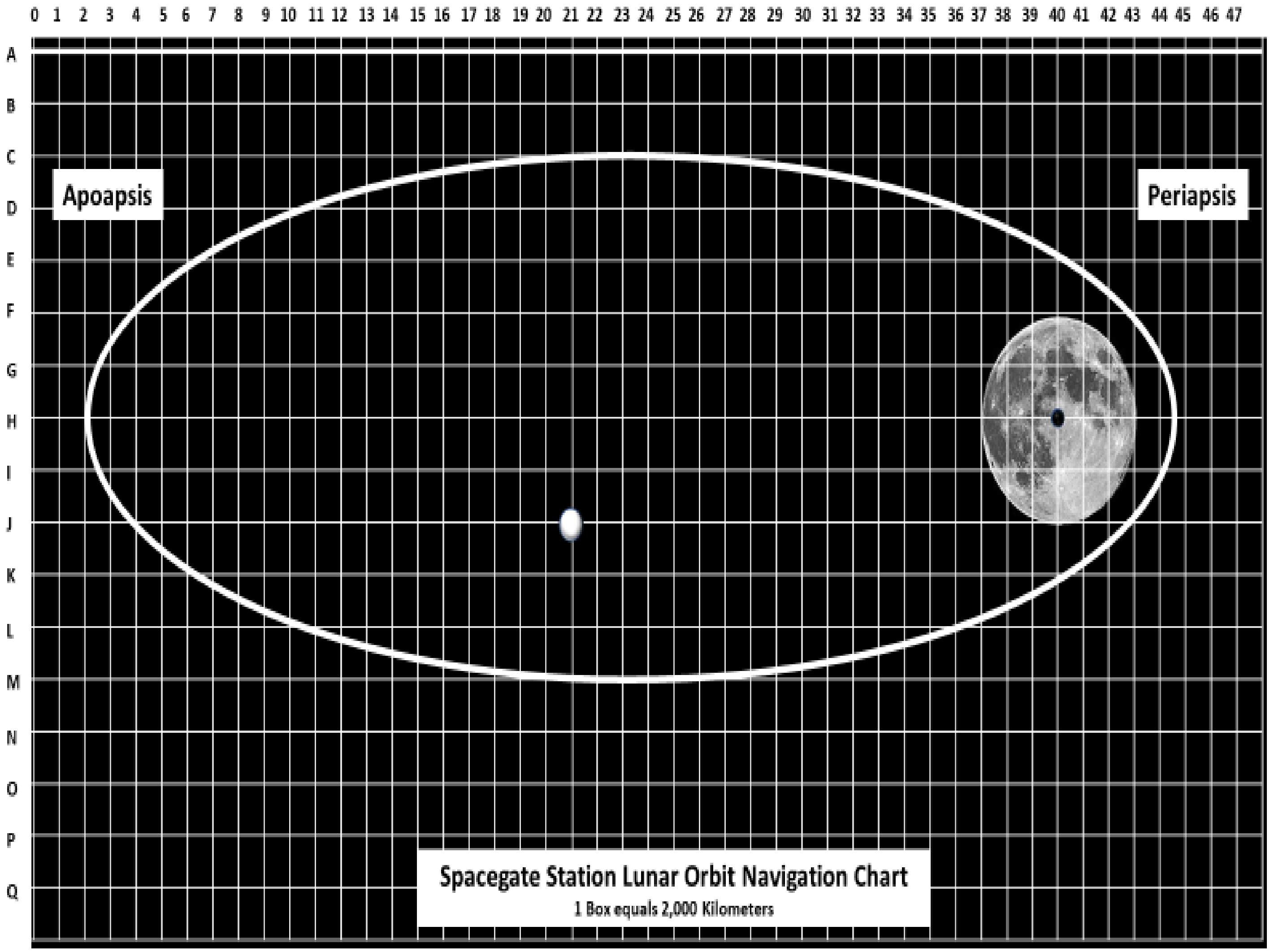



1. Present location of the station K27.
2. Desired location of the station M27.
3. Distance from present location to desired location 4,000 Km.
4. The present orbital velocity **7.65** Km/sec.

$$\text{Burn time (in seconds)} = \frac{4000\ \text{Km}}{7.65\ \text{Km/sec}}$$

Burn time (in seconds) = **523 seconds**

## Practice 1




Determine the burn time to change orbit:

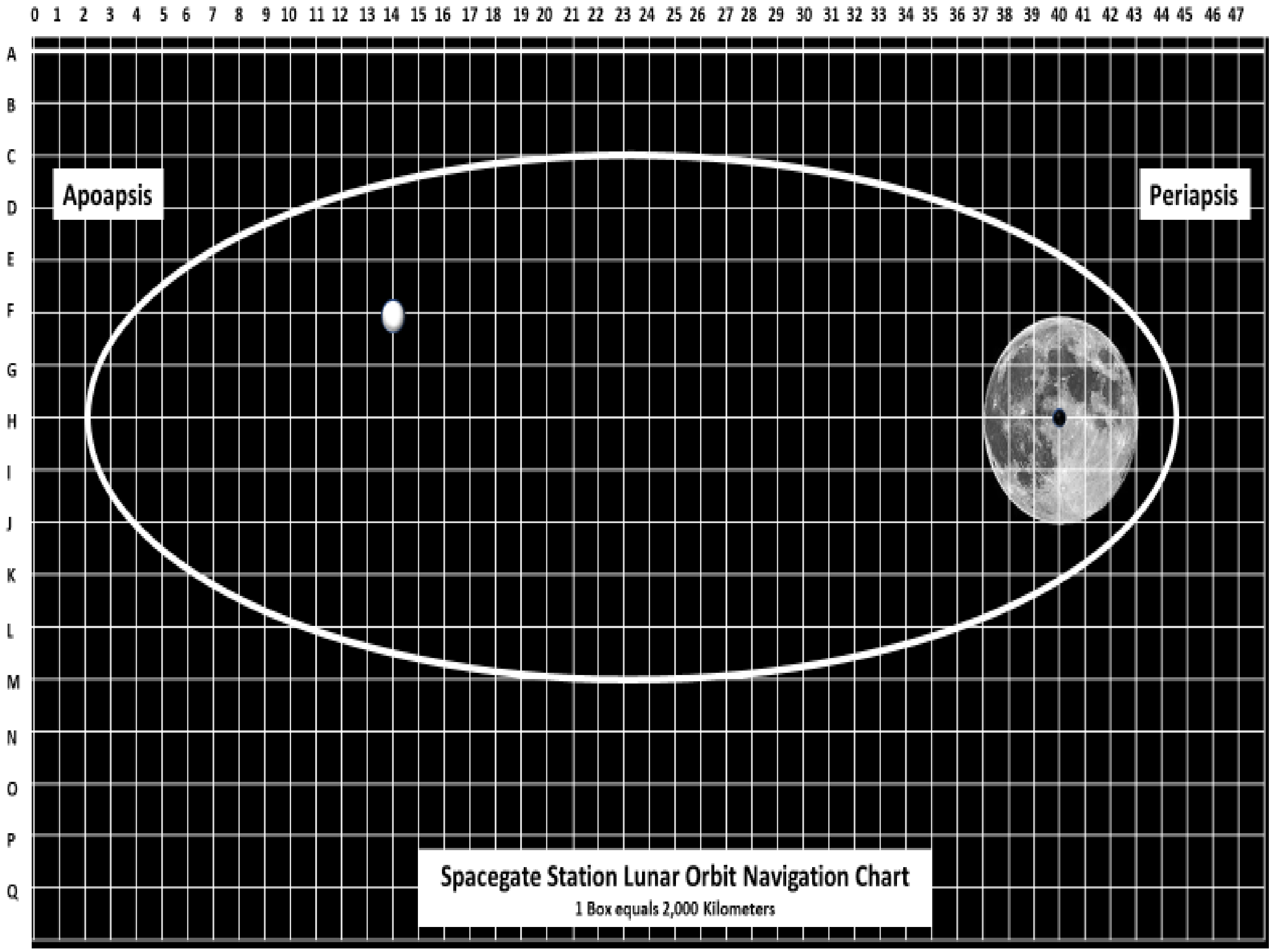
**Answer =** _____________ seconds (remember to round to the nearest whole number).

1. Present location of the station _______
2. Desired location of the station _ _____
3. Distance from present location to desired location _______Km.
4. The present orbital velocity is **9.84 Km/sec**

Burn Time = ______________________

1

## Practice 2




**NOTE:** *When selecting the station or orbit location, if it is located between lines the letter closest to the top is selected and the distance is halved (1,000, Km).*

Determine the burn time to change orbit:

**Answer =** ____________ seconds (remember to round to the nearest whole number).

5. Present location of the station _______
6. Desired location of the station _ _____
7. Distance from present location to desired location _______Km.
8. The present orbital velocity is **8.87/Km/sec**

Burn Time = ______________________

1

## ANSWERS

Practice 1

Determine the burn time to change orbit.

1. Present location of the station J21
2. Desired location of the station M21
3. Distance from Present location 6,000 Km
4. Present Orbital Velocity 9.84 Km/sec
5. **Answer - Burn Time 610 seconds**

Practice 2

Determine the burn time to change orbit.

1. Present location of the station F14
2. Desired location of the station C14
3. Distance from present location to desired location 5,000 Km.
4. Present Orbital Velocity 8.87 m/sec
5. **Answer – Burn Time 564 seconds**

## Next Generation Sunshine State Standards (Florida)

SC.3.E.5.4 Explore the Law of Gravity by demonstrating that gravity is a force that can be overcome.

SC.4.N.1.1 Raise questions about the natural world, use appropriate reference materials that support understanding to obtain information (identifying the source), conduct both individual and team investigations through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.

SC.4.N.1.5 Compare the methods and results of investigations done by other classmates.

SC.4.P.12.2 Recognize that an object in motion always changes its position and may change its direction.

SC.5.P.13.1 Identify familiar forces that cause objects to move, such as pushes or pulls, including gravity acting on falling objects.

SC.5.P.13.2 Investigate and describe that the greater the force applied to it, the greater the change in motion of a given object.

SC.5.P.13.4 Investigate and explain that when a force is applied to an object but it does not move, it is because another opposing force is being applied by something in the environment so that the forces are balanced.

SC.5.E.5.1 Recognize that a galaxy consists of gas, dust, and many stars, including any objects orbiting the stars. Identify our home galaxy as the Milky Way.

SC.6.N.1.4 Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.

SC.6.P.13.1 Investigate and describe types of forces including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational.

SC.6.P.13.2 Explore the Law of Gravity by recognizing that every object exerts gravitational force on every other object and that the force depends on how much mass the objects have and how far apart they are.

SC.6.P.13.3 Investigate and describe that an unbalanced force acting on an object changes its speed, or direction of motion, or both.

SC.7.N.1.2 Differentiate replication (by others) from repetition (multiple trials).

SC.7.N.3.2 Identify the benefits and limitations of the use of scientific models.

SC.8.N.1.1 Define a problem from the eighth grade curriculum using appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

SC.8.P.8.2Differentiate between weight and mass recognizing that weight is the amount of gravitational pull on an object and is distinct from, though proportional to, mass.

SC.8.E.5.1Recognize that there are enormous distances between objects in space and apply our knowledge of light and space travel to understand this distance.

SC.8.E.5.4 Explore the Law of Universal Gravitation by explaining the role that gravity plays in the formation of planets, stars, and solar systems and in determining their motions.

SC.8.E.5.10 Assess how technology is essential to science for such purposes as access to outer space and other remote locations, sample collection, measurement, data collection and storage, computation, and communication of information.