
# Engaging Students in Space-Related Problems

## PLTW Flight and Space

### What is Project Lead The Way?

- Students experience **real world experiences and problems** like those of real-world professionals
- Includes comprehensive PD that **empowers teachers of all backgrounds** to facilitate learning
- Learning is connected to **transportable skills** and relevant **careers**

# Key Qualities of the Flight and Space Curriculum

- Recommended for 6th Grade (also can be implemented with 7th or 8th grade students)
- 45-day unit
- No prerequisites

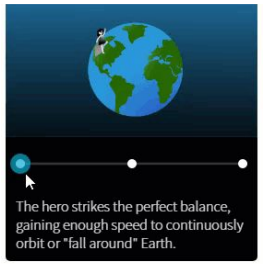
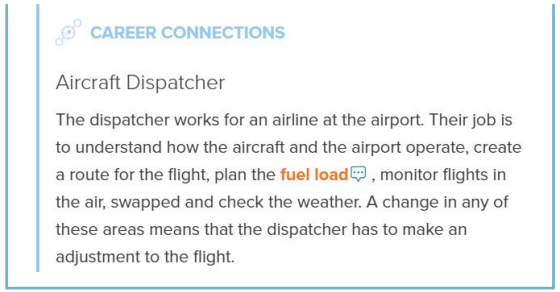


Figure 4. Launch to Orbit Trajectory

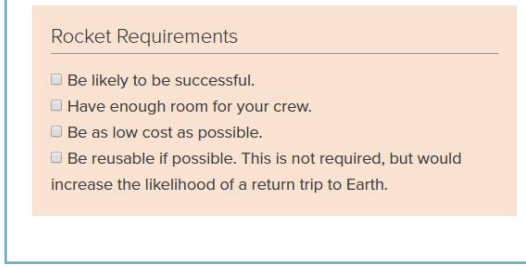
Engaging Content for Students


APB Approach & Scaffolding

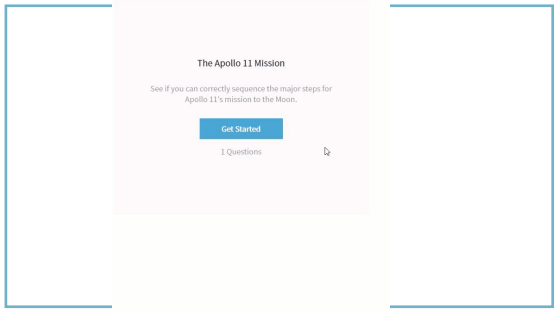



Career Connections


Ethics

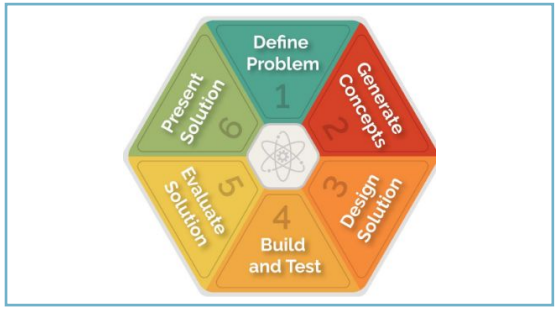



Student-centric Experiences that Allow for Creativity, Innovation & Transportable




Enhanced Media & Interactivity


Formative, Interim, & Summative Assessments Opportunities




Design Process Integrated Throughout

# Flight and Space

## Lesson 1
## Flight

- Activity 1.1: Instant Design Challenge
- Activity 1.2: Forces of Flight
- Activity 1.3: Test Flight
- Activity 1.4: Flight Planning
- Activity 1.5: Flight Management
- Project 1.6: Cleared for Takeoff

## Lesson 2
## Space

- Activity 2.1: Explorers of the Universe
- Activity 2.2: 3..2..1..Liftoff
- Activity 2.3: All Systems Go
- Activity 2.4: Out of this World Food
- Activity 2.5: Fit for Space
- Activity 2.6: Stayin' Alive
- Project 2.7: Take Two!

## Lesson 3
## Destination: Mars

- Problem 3.1: Mission to Mars
  - Task 1: Crews for a Cruise
  - Task 2: Ready for Countdown
  - Task 3: A Day in the Life
  - Task 4: Cleared for Landing
  - Task 5: Mars Lander Prototype

Activity 1.1

# Instant Design Challenge

## Design Brief

| | |
|---|---|
| Client | Ace Toy Company |
| Target Consumer | Toy glider enthusiasts |
| Ages | 8 and up |

### Problem Statement

Through their social channels, a toy company has received complaints that their balsa wood gliders have unpredictable flight paths. Customers comment that the gliders fly too low or too high, veer to the side, or land short of the target. The company wants to show that they are taking immediate action, but changing the production process and getting a new product out to dissatisfied customers will take weeks.

### Design Statement

Ace Toy Co. wants to develop and share examples of paper **prototypes** of improved gliders to post on social media.

You will create a successful paper airplane glider prototype with your partner.

### Design Requirements

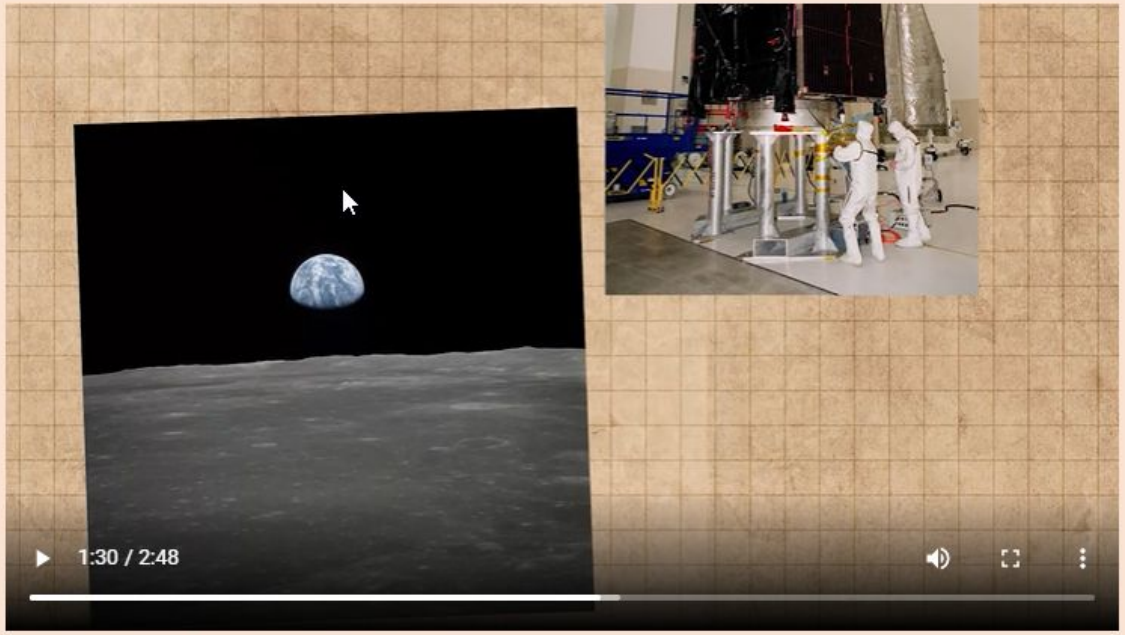
- Glider must be made from one sheet of 8.5" x 11" paper.
- Glider can be made with tape and/or paper clips.
- Glider must be built and tested during the time allowed.
- Launch must be from a horizontal position.
- Launch must start at the launch line and fly a minimum distance of 1.5 meters to successfully land on the target.

## Design Process

Now that you have worked with a team on an instant design challenge, you will reflect on the process you used as you learn about the **design process**.


## Flight and Space Unit Problem

Throughout this unit, you will learn and practice the skills you need to be ready to plan a mission for a crewed spaceflight to Mars!



Activity 1.2

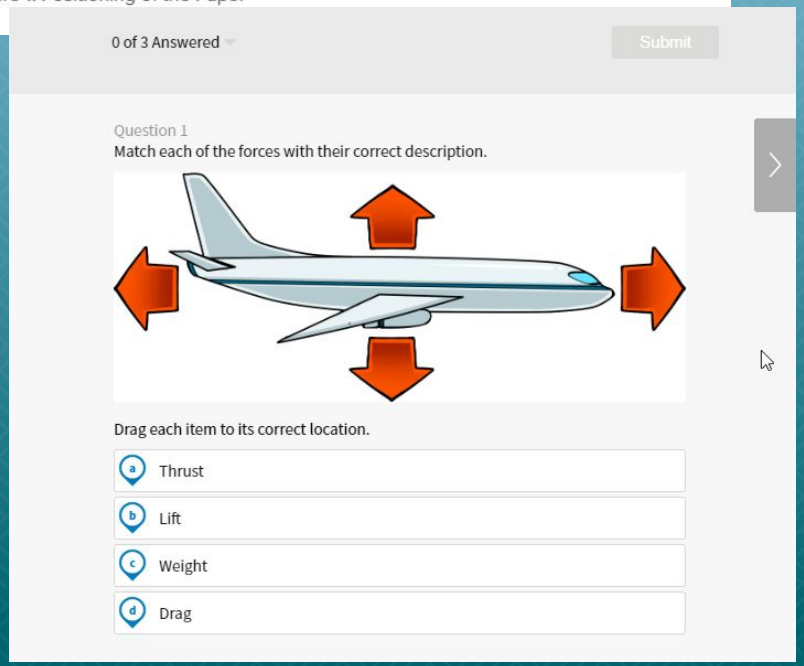
# Forces of Flight

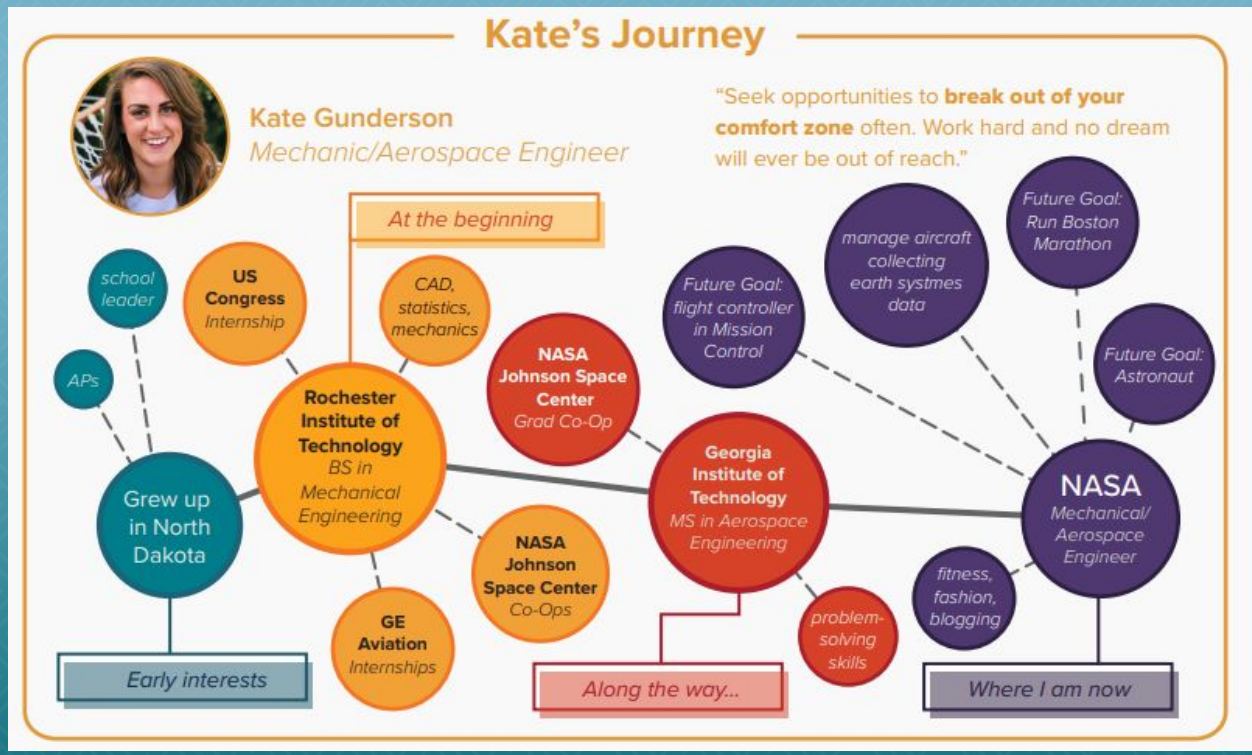
1. Get a strip of paper.
2. Place one end of the paper just below your lower lip and blow hard over the top of it, shown in Figure 1.

Figure 1. Positioning of the Paper

## Newton's First Law

An object at rest will remain at rest unless acted on by an **unbalanced force**. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force.




PROJECT LEAD THE WAY PLTW

Activity 1.3

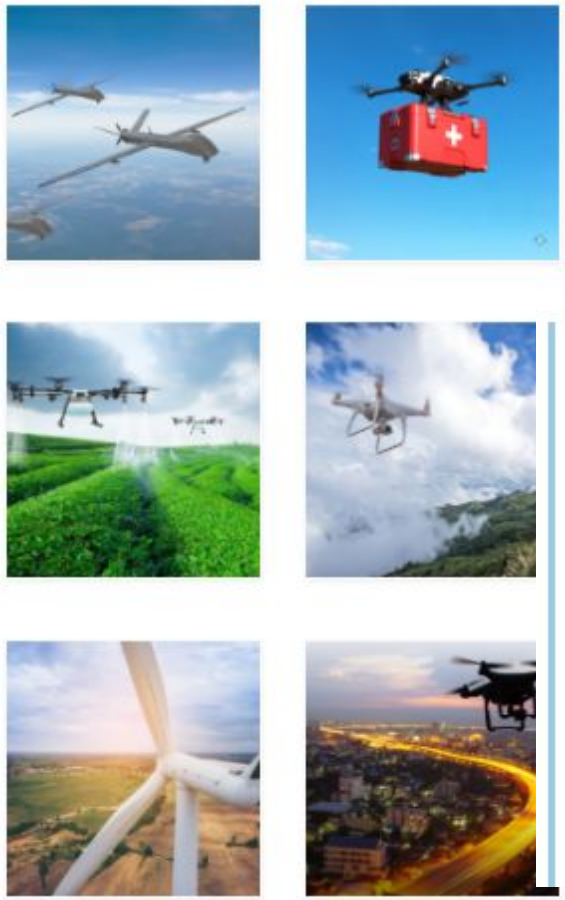
# Test Flight

CAREER CONNECTIONS

Drones

Even though their early use was mainly by the military, the use of unmanned aerial vehicles has truly taken off and expanded to many facets of life. The need for drone experts is on the rise across a wide range of industries. Engineers, programmers, pilots, and photographers are among the numerous careers related to the development and operation of drones.

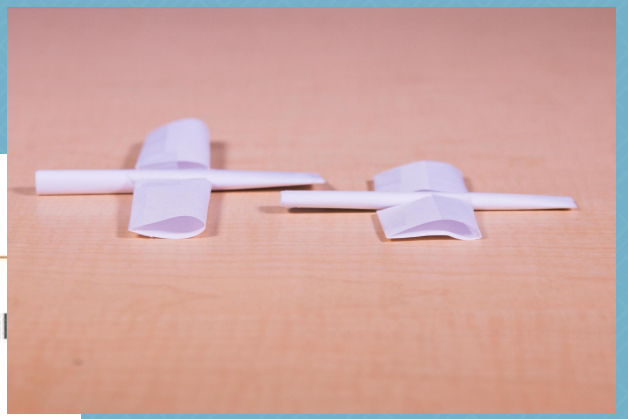
13 Explore the amazing ways drones are used today.



## Parts of an Airplane

So, how can you change an airplane's pitch, yaw, and roll? A pi
constantly varies the airflow around an airplane to affect the
balance of the four forces of flight. To make these changes in
airflow, pilots make small adjustments to the airpl
throughout the flight.

3 Hover over the hot spots on the diagram b
about the different parts of an airplane.



## Things are Shaping Up

As you learned in the previous activity, the movement of air around an airplane's wings produces lift. The shape of the wing and its position in the air makes a big difference in how an airplane flies. Looking at the wing from the side, the wing shape you see is called an **airfoil**.


Figure 3. Side View of a Cessna Airplane Wing

The shape and size of an airfoil affects how much lift and drag are produced. That is why airplane wings do not all look the same.

### PLTW GATEWAY NOTEBOOK

Now that you know how changing the shape of parts affects the plane's movement, test your knowledge!

1. If you are the pilot and you want the plane to roll toward the right, what part(s) would you move and how would you move it?
2. If you wanted the plane to pitch up, what part(s) would you move? How would you move it/them?
3. If you are trying to land the plane, which part(s) would you move? How would you move it/them?

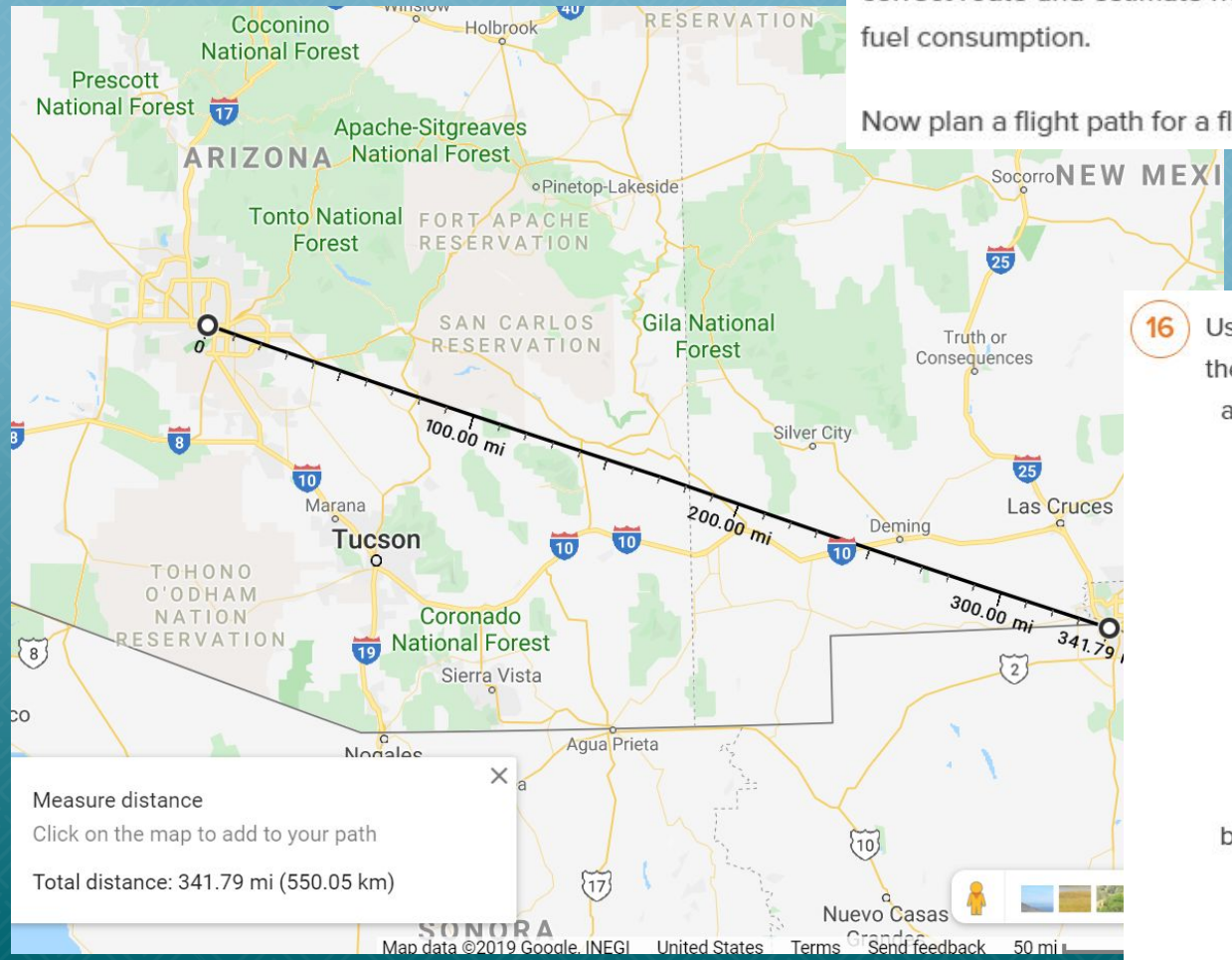
Activity 1.4

# Flight Planning

## Departure and Checkpoints

Checkpoints are landmarks that are easily visible from the air. When planning a flight, the pilot or dispatcher determines checkpoints along the route that help the pilot to stay on the correct route and estimate how much fuel has been used, called fuel consumption.

Now plan a flight path for a flight from Phoenix, AZ to El Paso, TX.




## Flight Information

- Plane: Cessna 182 Skylane

| Range (maximum distance aircraft can travel on a tank of fuel) | Cruising Speed (average cruising speed, doesn't count takeoff and landing speeds) | Fuel Capacity (how much fuel the tank can hold) |
|---|---|---|
| 820 NM | 140 kts | 88 US Gallons |

- Departure: Meriden Markham Municipal Airport near Cheshire, Connecticut at 08:00 on July 20th
- Arrival: Sawyer International Airport in Gwinn, Michigan

**16** Use the Flight Information and Google maps to complete the Flight Plan.

a. Determine or calculate the following information:

- Alternate destination airport
- Distance between departure and arrival airports
- Flight time

$$Time\ (hours) = \frac{Distance\ (NM)}{Speed\ (kts)}$$

- 6 Checkpoints spaced about 100 NM apart (100 NM ≅ 115 miles)
- Description of each checkpoint identifiable on a sectional map

b. Fill in all missing information in the Flight Plan.

> **Note**: Use the same time zone for both the departure city and arrival city.

**13** Determine whether you will have enough fuel to fly a Cessna 182 Skylane from Phoenix to El Paso without refueling along the way.

> **PLTW GATEWAY NOTEBOOK**
> Will you have enough fuel? Why or why not?

PROJECT LEAD THE WAY PLTW

Activity 1.5

# Flight Management

## Travel Scenario

A passenger is at the airport waiting at the **gate** to board flight 1742.

An announcement over the loudspeaker says, "Attention passengers for flight 1742, your flight has been delayed."

Curious about this, the passenger goes to the service agent at the counter. "Do you know how long the flight will be delayed?" she asks.

"It will be about 30 minutes. The crew could not get here due to bad weather in their departure city. We have another local crew that is on their way. It wor
agent.

The passenger settles back int
she has time to work on the cr
hoping to finish.

## Gantt Get It All Done

Managing individual flights and airport operations requires careful scheduling! Although middle school life is not as complicated as flight management, your day requires careful scheduling, too. Planning after school time can be tough for a busy student. There are only a few hours between the last class of the school day and bedtime. From doing homework, to helping around the house, you may feel overwhelmed trying to schedule it all. But with a special planning tool called a **Gantt chart** , you can go from "*Can't* get it all done" to "*Gantt* get it all done"!

| | 06:00-07:00 | 07:00-08:00 | 08:00-09:00 | 09:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-13:00 | 13:00-14:00 | 14:00-15:00 | 15:00-16:00 |
|---|---|---|---|---|---|---|---|---|---|---|
| Flights | | | | | | | | | | |
| DTW > ORD 7:50-10:16 | | | | | | | | | | |
| ORD > DTW 12:30-14:54 | | | | | | | | | | |
| Captain | | | | | | | | | | |
| A.Hernandez | | | | | | | | | | |
| C. Johnson | | | | | | | | | | |
| E. Williams | | | | | | | | | | |
| First Officer | | | | | | | | | | |
| B.Brown | | | | | | | | | | |
| K. Garcia | | | | | | | | | | |
| Y. Patel | | | | | | | | | | |
| Flight Attendant | | | | | | | | | | |
| F. Anderson | | | | | | | | | | |
| L. Jones | | | | | | | | | | |
| M. Smith | | | | | | | | | | |
| T. Wong | | | | | | | | | | |

## Crew Scheduling Rules

- Crew must rest and not fly f
previous flight ended.
- Crew are not allowed to exceed 60 hours of flight time per week.
- Crew who have the most seniority are the first to get a trip.
- If a person is not available to fly, do not show a colored bar after their name. Leave it blank.

### PLTW GATEWAY NOTEBOOK

a. Select the the option that you think is the best choice to keep passengers on schedule. Provide evidence that supports your choice.
b. Select the option that you think is the best choice to keep passengers safe. Provide evidence that supports your choice.
c. If you were the dispatcher, which option would you choose?

## 05:00 Flight Risk

At 12:30 on January 27th, a dispatcher and a crew scheduler working at Chicago O'Hare International Airport check the weather map.

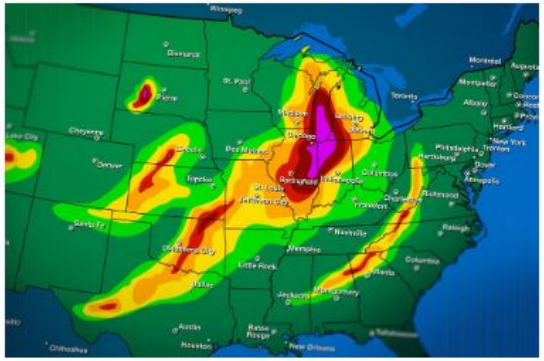


Figure 8. Weather Forecast Map

It shows that ice, snow, and rain are going to hit Chicago. Both employees immediately begin to think about the 05:00 flight that is scheduled. They recognize that they need to have a plan ready to deal with the weather.

PROJECT LEAD THE WAY PLTW

Project 1.6

# Cleared for Takeoff

## PLTW Aviation Experts

An airline company, AirOne Airlines, has decided to add a new nonstop route between Minneapolis, MN and Los Angeles, CA. They have hired your firm, *PLTW Aviation Experts*, to develop the plans necessary to make this happen. As part of the team wo on this project, you and your group are responsible for three tasks:

- Complete a flight plan for the route.
- Create a crew schedule for the flight.
- Design and create a prototype for the aircraft that will fly new route.

Work collaboratively within a team to complete your tasks. S the work fairly across all team members and make sure to fo the team norms you developed earlier in this lesson. At the e this project, you will submit your group's solution for the thre tasks to the Board of Directors for AirOne Airlines, and they determine whether or not your solution will be developed.


### Flight Information

- AirOne Airlines has requested your aircraft must have the following specs:

| Range | Cruising Speed | Fuel Capacity | Maximum Flight Time | Total number of passengers |
|---|---|---|---|---|
| 3,900 NM | 458 kts | 11,489 gals | 8.5 hours | 226 |

- Departure: Minneapolis-Saint Paul International Airport (MSP) at 08:45 on December 19
- Arrival: Los Angeles International Airport (LAX)

## Design Brief

| | |
|---|---|
| Client | AirOne |
| Target Consumer | Airline Passengers |
| Ages | All ages |

### Problem Statement

*The need for flights to the western part of the United States has increased. To meet the need, AirOne Airlines is adding a new route and a new jet. The new route needs to travel between two large cities, Minneapolis, MN and Los Angeles, CA, to serve a large number of people. The route requires a jet that can easily travel a long distance.*

### Design Statement

The Board of Directors at AirOne has hired your firm to design and create a prototype for the aircraft that will fly the new route.

With a team, you will create and test a prototype that can travel a long distance, accurately. Use what you have done and learned throughout the lesson to design your prototype to submit to AirOne.

### Design Requirements

- Must start at the launch line and fly a minimum distance of 3 meters to successfully land on the landing strip.
- Must be stable as it flies—no flips in the air.
- Must land safely—no crash landings.
- Must land with at least half of its fuselage in the gray area on the landing strip.
- Must use only the materials provided.
- Must be built and tested during the time allowed.
- Must record the results of at least three test launches

Activity 2.1

# Explorers of the Universe

## Game Rules

### Number of Players

4–8 players

### Goal

The goal of the game is to be the first team to answer questions correctly to fill in four squares in a row (horizontally, vertically, or diagonally) on your tracking sheet.

### How to Play

1. Place the game cards face down in category stacks.
2. Determine who will go first.
3. Roll the die.
   a. If you rolled a Red, your turn is over.
   b. If you rolled a Purple, you get to pick the category you want to play.
   c. For any other color, you play the category that matches in color.
4. Have the opposing team draw a card from the appropriate stack and read the question on the card.
   a. If your team answers correctly, shade in a matching square on your tracking sheet.
   b. If your team answers incorrectly, your turn is over.

   > **Note**: Whether your team has answered correctly or incorrectly, the opposing team must read the entire answer section on the card, as it contains additional interesting information.

5. The team to shade in four squares in a horizontal, vertical, or diagonal row on the tracking sheet first wins the game!



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Activity 2.2

# 3...2...1...Liftoff

# It's a Blast!

A prestigious space exploration company, SpaceJourney, needs your help to develop the best propellant for launching rockets. Put on your rocket scientist hat and test different combinations of chemicals to determine the best formula for rocket fuel. Your hard work will ensure the company propels to the top!

In this activity, you will investigate how different amounts of fuel produce different amounts of thrust. To complete this investigation, you will use a balloon propulsion system, which will use air as the fuel. You will use the distance the balloon rocket able to travel to measure the amount of thrust produced.

**PLTW GATEWAY NOTEBOOK**

Create a data table in your notebook:

| Amount of Fuel (# pumps) | Trial 1 Distance Traveled (m) | Trial 2 Distance Traveled (m) | Trial 3 Distance Traveled (m) | Average Distance Traveled (m) |
|---|---|---|---|---|
| 3 Pumps | | | | |
| __ Pumps | | | | |
| __ Pumps | | | | |

2 Create a balloon rocket.

5 Review the different chemicals SpaceJourney has identified for testing.

| Liquid Chemicals | Solid Chemicals |
|---|---|
| Vinegar | Alka-Seltzer |
| Water | Tums |
| Soda pop | Baking soda |

**PLTW GATEWAY NOTEBOOK**

Which rocket fuel formula would you recommend to SpaceJourney? Support your recommendation with evidence.

Your teacher will assign you and your partner one liquid chemical to test with each of the various solid chemicals.

**PLTW GATEWAY NOTEBOOK**

Predict which combination of liquid chemical with solid chemical will cause the canister rocket to launch the highest distance.

PROJECT LEAD THE WAY PLTW

Activity 2.3

# All Systems Go

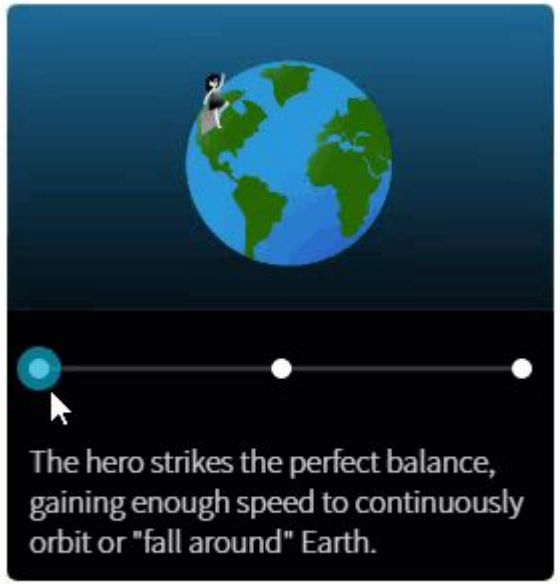
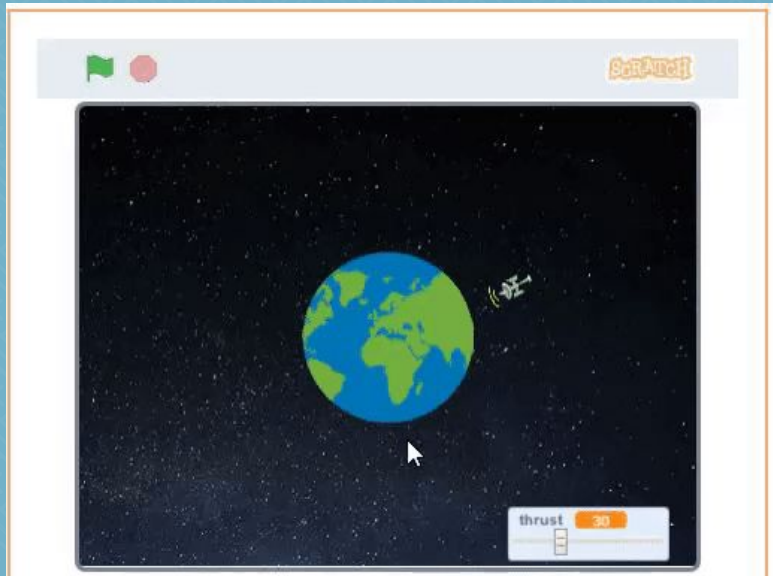


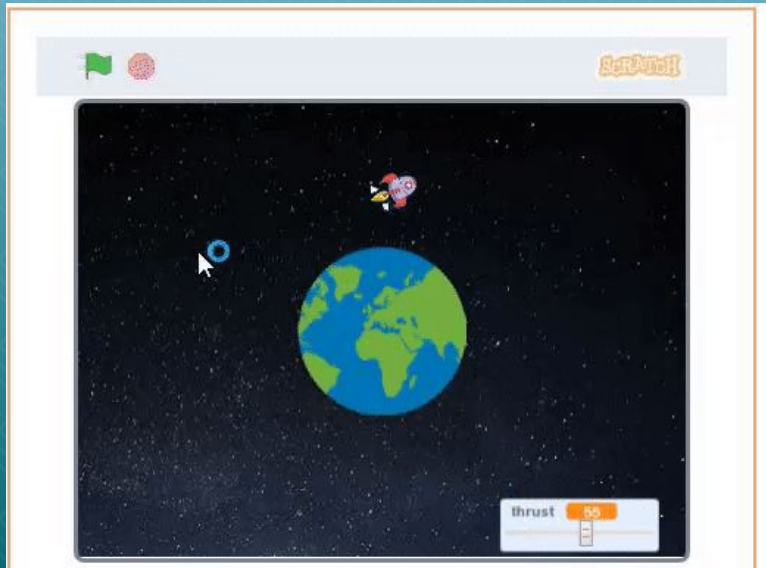

Figure 4. Launch to Orbit Trajectory

## A Historic Mission

Now that you have explored the various components of a mission, from launch, to cruise, to landing, let's look at one of history's most significant space missions—the Apollo 11 mission. The Apollo mission, conducted by the United States, marked the first time humans left Earth and landed on another body in our Solar System. The three astronauts aboard the Apollo 11 space capsule embarked on their historic mission in the summer of 1969, launching from Cape Canaveral, Florida, and landing safely on the Moon three days later.




Thrust Simulation




Thrust Simulation

## Experimenting with Orbits

Whether you are planning a mission to the Moon or planning a mission to Mars, if your launch trajectory sent your spacecraft into orbit around Earth, you would then have to get your spacecraft out of orbit and on its way to its next destination.

In this activity, you will work in a team of four students. You will use a model to investigate what it takes for a spacecraft to escape orbit.

## Sticking the Landing

When you've reached your destination, your mission is not over. You still need to slow the spacecraft down and then land safely on the surface of the planet or moon. **Landing** is the process of touching a spacecraft down safely on the surface of its destination planet or moon. There are four methods for slowing and landing the spacecraft: **parachutes**, **retro-rockets**, **airbags**, and **sky cranes**.

10 Explore the methods used to land spacecraft in Figure 9.

# Microgravity Meals

In this section, you explore eating in space! On Earth and in space, people eat food to supply energy and nutrients to fuel their bodies. But the **microgravity** of spaceflight means that astronauts experience mealtime differently.

Figure 1. Astronaut Julie Payette Pr

Source: NASA

2 Calculate the calorie needs for a person in space.

PLTW GATEWAY NOTEBOOK

Record all calculations in your notebook.

a. Review the example problem and solution.

**Example problem**: In space, a human requires 125% of the calories needed on Earth. For a person who needs 1900 calories on Earth, how many calories do they need in space?

**Example solution**:

Space calories = 125% of Earth calories

= 1.25 × (1900 calories)

= *2375 calories*

b. Use the example problem and solution to calculate the calories needed for the following people:

- For a person who needs 2200 calories on Earth, how many calories do they need in space?
- For a person who needs 2500 calories on Earth, how many calories do they need in space?

You are training to be an astronaut for the next mission aboard the ISS. To prepare for your mission, you need to learn how to create the various meals you will cook while in space. Your first assignment is to use a common astronaut food prep technique, called **rehydration** . You will use rehydration to make a simple, delicious treat—astronaut pudding.

4 Use rehydration to make astronaut pudding.

**Note**: Each student in your group will make their own serving of astronaut pudding.

**Step 3:** Using a spoon, scoop a small amount of pudding powder into the bag.

Activity 2.4

# Out of This World Food

## Space-Farm to Table

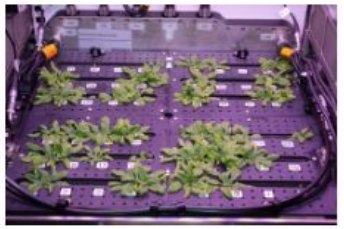


Figure 4. Plants Growing on the ISS

Source: NASA

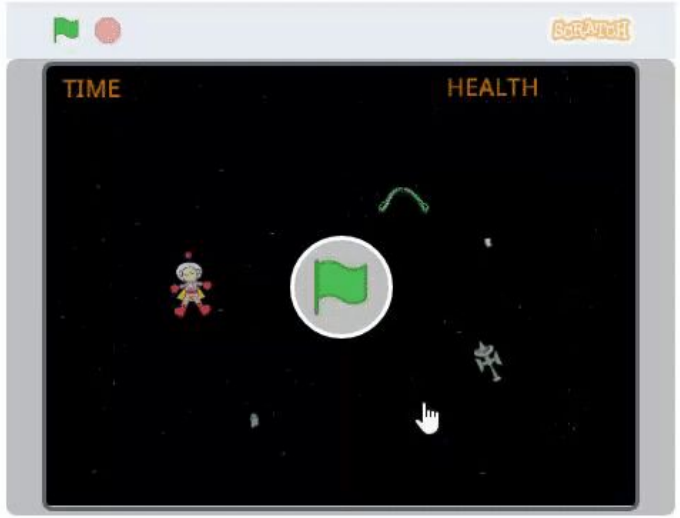
In this section, you will explore growing food off-Earth. For a long space mission like one to Mars, you cannot take all the food needed to sustain life for the journey and at the base you will set up. You will have to plan another way to feed your crew for many months or years. How will you get the food you will need?

You and your crew will need to grow crops to feed yourselves, and you will need to do it in a fast and efficient way. Researchers on the ISS have been experimenting with the best ways to grow plants like those shown in Figure 4. Researchers on Earth have been testing different crops in isolated environments to find out what will grow best for future colonies on other planets. Your job is to examine their data to help you plan your Mission to Mars!

PROJECT LEAD THE WAY PLTW

Activity 2.5

# Fit For Space




Fit for Space! Game

**Reflection**: Which of the following effects do you think happen to the human body after spending a month in space? Why do you think these occur?

- Loss of bone strength
- Loss of muscle strength
- Changes in aerobic capacity
- Changes in sight
- Changes in ability to think and concentrate

## Fit for Space! Game Rules

### Goal

The goal of the game is to earn the highest score possible within 90 seconds.

- Earn points by bumping into items that contribute to an astronaut's health.

| Drink | Apple | Tortilla | Exercise | Sleep |
|---|---|---|---|---|
| +10 points | +10 points | +10 points | +10 points | +10 points |

- Avoid environmental hazards that could endanger the astronaut.

| Radiation | Space Junk | Asteroid |
|---|---|---|
| -10 points | -10 points | -10 points |

- Earn extra points by collecting and reading Incoming Messages.

Messag
+20 Poin
+5 Secon

## Designing and Testing an Exercise

Now that you have learned how astronauts exercise in space, you and your team will design muscle strengthening exercises for astronauts to do using resistance bands. Resistance bands are made of a stretchy material that your muscles have to work against, regardless of whether there is gravity or not! This makes using resistance bands a great option to "weight train" in space. Pulling a resistance band in different ways works different muscles.

5 Decide which team member will be the Recorder/Safety Officer, Space Fitness Trainer, and Astronaut Tester.

| Role | Responsibility |
|---|---|
| Recorder/ Safety Officer | Responsible for documenting your team's actions, comments, and results. Also responsible for monitoring exercise to ensure safety of the tester and others. |
| Space Fitness Trainer | Responsible for using knowledge of muscle anatomy to design an exercise that will work a target muscle. |
| Astronaut Tester | Responsible for testing an exercise and reporting on the effectiveness of the exercise in working the target muscle. |

e a muscle, you must pull on the resistance band so that
e has to work to move in the direction you want. Let's
w resistance bands can be used to exercise the
s muscles (front thigh) and hamstring muscles (back

6 Use the resistance band to exercise the quadriceps muscle and hamstring muscle.

Figure 5. Quadriceps Muscle Exercise

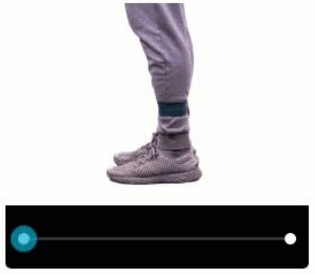
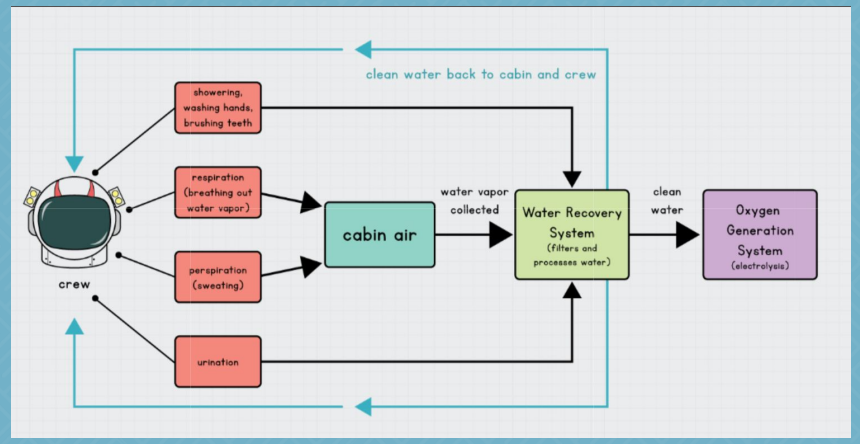


Figure 6. Hamstring Muscle Exercise

PROJECT LEAD THE WAY PLTW

Activity 2.6

# Stayin' Alive




## Water Filtration System

You will work with a team to build your own water filtration system.

17. Join a team as directed by your teacher.
18. Gather the materials for your filter:
    - Safety goggles and gloves
    - 16 oz water bottle (already cut into two pieces)
    - Scissors
    - Permanent marker
    - Rubber band

## Life Support Systems Aboard a Spacecraft

Missions to other planets can take months, or even years, to complete. For instance, it can take at least seven months to get to Mars, which is just the next planet in our solar system! Given the limited amount of resources that could be carried on a mission to Mars, special life support systems would need to be used to recycle the available resources.

Similar systems were already developed for the ISS to provide:

- Clean air and water
- Controlled humidity, temperature, and air pressure
- Effective waste management

This will insert a new line chart representing the data in your table. Figure 8 shows a sample line chart.

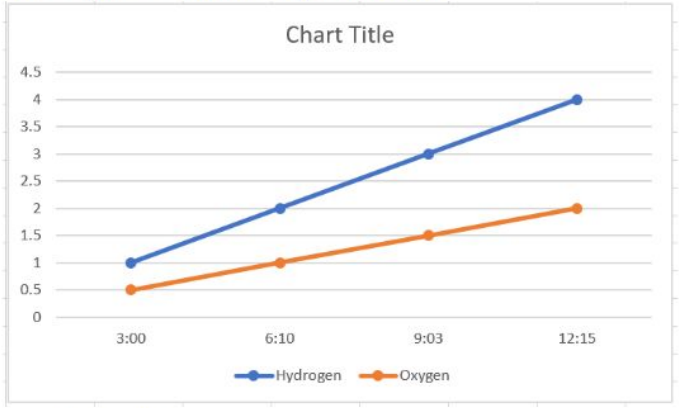



Figure 8. Line Chart

9. Double click on the Chart Title and change the title to "Gas Volume over Time".
10. Save your file.
11. Analyze the line chart.
    a. What do the numbers on the horizontal axis represent?
    b. What do the numbers on the vertical axis represent?
    c. What do the two colored lines represent?
    d. How do the values on the hydrogen line compare to the values on the oxygen line?

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# Putting it All Together!
# Problem 3.1 Destination: Mars

# PLTW Space Explorers

A space company, MarsToo, is making preparations to send the first manned mission to Mars. A few unmanned trips have been successful in delivering landers and rovers, but it is time to safely land the first humans on the red planet. MarsToo needs to develop a plan that provides a way to travel to, land on, and live on Mars.

They need your help! MarsToo has hired your team to plan part of the mission. They need you to:

- Choose a reliable, resilient and knowledgeable crew
- Provide the specifications for a vehicle for the journey
- Plan a schedule of routine activities
- Select a landing site on Mars
- Create a model for a landing vehicle



# Task 1: Crews for a Cruise

For this task, you are responsible for assembling your astronaut crew for the mission to Mars. This mission requires a crew of either four or six astronauts. It is your job to pick from the astronaut candidates to select the strongest crew possible for the mission. Once you pick your crew, you will need to pick the rocket necessary to get your chosen crew to Mars safely.

## Crew Requirements

- Crew must contain 4 or 6 astronauts
- Crew must have one commander
- Must have at least two crew members for each category on the Astronaut Skills and Experience Summary chart (Figure 1).
- Each crew member must be skilled in at least three areas

**E. Domingo**

- MS aerospace engineering
- Worked at the Antarctic research station for two years
- Expert on uses of fuel in remote locations
- Winner of annual NASA chili cookoff

**A. Michael**

- MS aviation systems
- Commander on the ISS
- Most days spent in space of any astronaut
- Created a computer language that is now the industry standard

**L. Phillips**

- MS mechanical engineering
- Helicopter test pilot
- Ran a military safety and training post
- Enjoys spending weekends doing wilderness and water survival trips

**S. Scott**

- MD emergency medicine
- Discovered a new treatment for musculoskeletal disorders
- U.S. Army ranger with numerous special operations raids completed
- Competitive skydiver

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# Task 2: Ready for Countdown

Now that you have chosen the crew for you mission, you have to choose the vehicle that can get your crew safely to Mars.

### Rocket Requirements

- ☐ Be likely to be successful.
- ☐ Have enough room for your crew.
- ☐ Be as low cost as possible.
- ☐ Be reusable if possible. This is not required, but would increase the likelihood of a return trip to Earth.

| Rocket Type | Reusable | # of Successful Launches | Payload Capacity | # of Passengers | Cost Per Launch | Additional Information |
|---|---|---|---|---|---|---|
| Beast with Targa Capsule | Partially reusable | Beast: 51<br>Targa: 0 | 16800 lbs | 7 | $90 million | Needs supplies sent ahead - added cost $17 million per person |
| Space Mission System(SMS) with Dipper Module | Not reusable | SMS: 0<br>Dipper: 0 | 99000 lbs | 4 | $14 billion | Very high success rate predicted |
| 6 Veloci Engines with Astroship | Reusable | Veloci Engine:0<br>Astroship: 0 | 220000 lbs | 99 | $6 billion | •Can carry many passengers for colonization<br>•A large vessel such as this has never been launched before<br>•Possible return trip |
| Galaxy Rocket with Stella Cruiser Capsule | Not reusable | Galaxy Rocket: 68<br>Stellacruiser: 1 | 19620 lbs | 7 | $110 million | •High success rate predicted<br>•Relies on a transfer orbit to boost to Mars<br>•Needs supplies sent ahead - added cost $17 million per person |

Figure 1. Rocket Specifications

# Task 3: A Day in the Life

In this task of your mission, you will schedule the astronauts' tasks for one day aboard the spacecraft during the cruise to Mars.

**ONBOARD PLAN VIEWER**

| Houston | 07:00 - 08:00 | 08:00 - 09:00 | 09:00 - 10:00 | 10:00 - 11:00 | 11:0 |
|---|---|---|---|---|---|
| ISS Commander M. Wargo | DPC | PAO KIDS TV | EXERCISE CEVIS | EXERCISE ARED | |
| C. Rosenberg | DPC | FREE | RR TEST | EXERCISE CEVIS | |
| Z. Chin | DPC | PAO KIDS TV | RR TEST | FREE | |
| **Constraints** | | SSC-10 UNAVAILABLE | | | |

Figure 1. Snapshot from Onboard Plan Viewer (OPV)

| | |
|---|---|
| DPC | Daily Planning Conference |
| EMERG | Emergency Drill |
| EVA | Extra-Vehicular Activity, such as a spacewalk |
| FREE | Free time |
| PAO | Public Affairs Office - recording video footage |
| SSC | Spacecraft Support Computer |

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# Task 4: Cleared for Landing

One of the biggest decisions for a Mars mission is where to land on the planet's surface. In this task, you are responsible for that decision.

## Landing Site Considerations

1. Difficulty of landing and travelling on terrain (size, roughness)
2. Elevation is safe for landing (is 0.5 km or less)
3. Potential frozen water available
4. Possible signs of microbial life
5. Moderation of temperature extremes
6. Radiation shielding (caves and lava tubes)
7. Energy source: solar energy available
8. Sufficient space to build a habitat

Figure 4. Gale Crater Landing Site

Source: NASA/JPL-Caltech/ESA/DLR/FU Berlin/MSSS

| | |
|---|---|
| **Size** | 96-mile diameter |
| **Location Info** | It is on the Martian equator. It contains flat areas as well as a mountain that rises 15,000 ft from the crater floor. |
| **Coordinates** | Long. Lat. |
| **Approximate Elevation** | |
| **Water** | Studies have shown that it once contained an ancient freshwater lake. |

# Task 5: Mars Lander Prototype

You have just one task left to complete—designing and creating a prototype for your Mars lander!

## Design Statement

With a team, you will design, develop, and test a prototype of a landing vehicle that can safely land humans on the surface of Mars at the chosen landing site.

## Design Requirements

- ☐ Must be tested/dropped from a height of 75 cm.
- ☐ Must be stable as it descends—no flips in the air.
- ☐ Must be designed to land on ground or ice, depending on the chosen landing site.
- ☐ Must land on the target (landing site).
- ☐ Must securely carry model astronauts made of clay. (Each model astronaut must have a mass of 15-25 grams.)
- ☐ Must be designed to carry the number of astronauts you identified for your crew in Task 1.
- ☐ Must keep the model astronauts from bouncing around or out of the lander upon landing.
- ☐ Must use only the materials provided.
- ☐ Must be built and tested during the time allowed.
- ☐ Must record the results of at least three test rounds.


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