ORBITRON STEM KIT

ACTIVITY BOOK

education

FOLLOW US

LEAFY LAUNCH

You have been recruited to help get a new space colony on Mars ready to go. Most of the tasks are complete except for cleaning the air and providing oxygen to the settlement. Your mission is to send plant saplings safely and efficiently to the colony using the provided equipment.

Your Mission

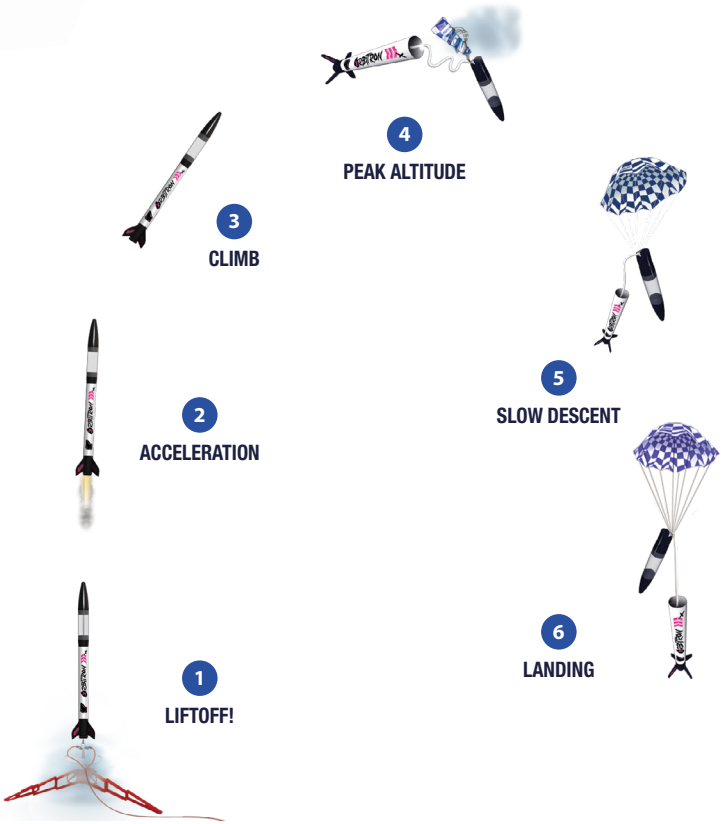
- **Send plant saplings safely and efficiently to the Mars colony using the provided equipment.**
- **Determine the proper combination of equipment and modifications to provide the saplings (the payload) with the fastest descent time to the colony.**

Remember, the saplings need to land as quickly and safely as possible so they can stay fresh and be planted straight into the ground.

Good Luck!

SCIENCE PRINCIPLES

This mission will focus on the concepts of **gravity**, **drag**, and **rocket recovery systems**. Let's talk about these for a moment. When you launch a model rocket, the thrust from the engine will propel the rocket up. When the fuel in the engine is used up, the rocket will start to descend, or come down, and the force of **gravity** will pull it back to Earth. The parachute in the model rocket will open and add **drag**, a force that opposes the rocket's motion, to slow it down and allow it to land safely. The parachute is known as a **recovery system**.



On the following pages you will find several different experiments to choose from that will include each of these science concepts. They will guide you to finding just the right combination of equipment and modifications to complete your mission!

Let's go!

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SAFETY FIRST!

Review each of these regulations from the National Association of Rocketry before you launch and check off each box to show that you understand it.

www.nar.org

Materials

- ☐ Only use materials provided in the rocket kit.
- ☐ Do not tamper with rocket engines in any way.

Launch Site

- ☐ Launch in an open outdoor area (A engines = 100 sq ft; B = 200 sq ft; C = 400 sq ft).
- ☐ Launch only in safe weather conditions (winds less than 20 mph).
- ☐ Be sure there is no dry grass near the launch pad.
- ☐ Do not launch at targets, into clouds, or near airplanes.

Launch

- ☐ Countdown before launch.
- ☐ Be sure everyone stands at least 15 feet away.
- ☐ Launch rod must be within 30 degrees of vertical.
- ☐ In case of misfire, wait 60 seconds before approaching the rocket.

Recovery

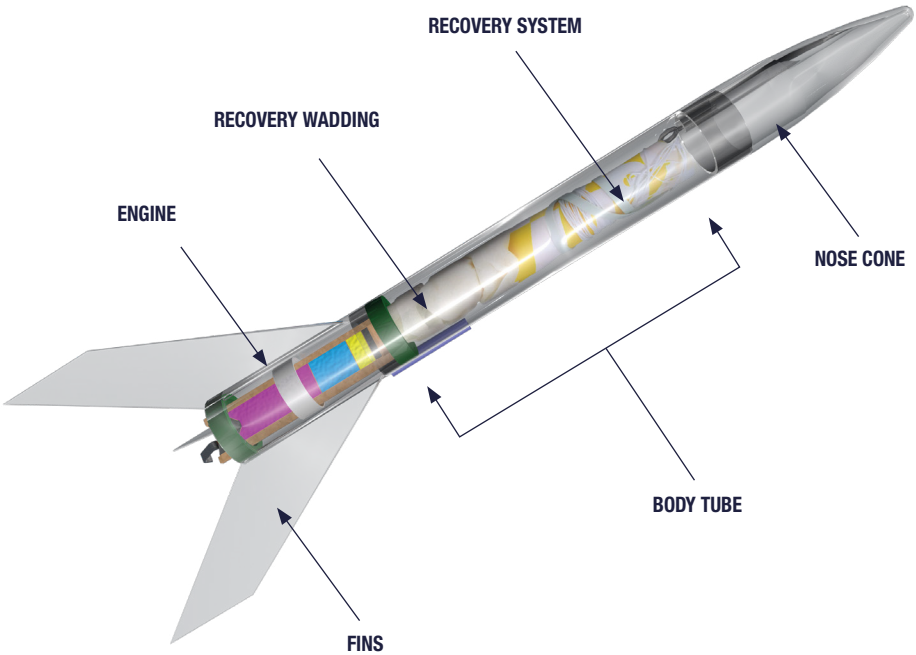
- ☐ Do not attempt to recover rocket from tall trees, powerlines, or other dangerous places.

PREPARE FOR LAUNCH

Now that you know the mission it is time to prepare your rocket. Be sure to follow these steps:

1. **Unload** all the pieces of your rocket and follow the included instructions carefully to correctly build the rocket.
2. **Decide** which experiments from the following pages you are going to perform.
3. **Prep** your rocket for launch by adding recovery wadding, folding your parachute, and inserting an engine.
4. **Look** over all the included safety guidelines and get an adult to assist you with the launch.
5. **Launch** and collect data.
6. **Make** modifications as suggested in the experiments. Launch again and collect data!

Model Rocket Parts



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ROCKET STABILITY TEST

Want to learn more about stability? Watch this video:

The stability of a rocket is very important. An unstable rocket is unpredictable and might not reach its maximum altitude. It is also more likely to crash and be unable to use again. There are two things you need to do to see if your rocket is stable: find the center of gravity, and perform a swing test.

Directions: For this activity you need your completed rocket and at least 12 feet of string.

First, determine the center of gravity (the point where the weight of the rocket balances):

- Take your rocket and balance it on your finger.
- When the rocket is balanced and still, mark the spot that is touching your hand. That is the center of gravity.
- Tie a string at this point.

Now for the stability test:

- Find an open area to perform this task.
- Gently swing the rocket around your head, like a lasso.
- If the rocket consistently flies in a steady circle, then it is a stable rocket. If it moves in an irregular pattern, it is unstable.

MAKE MODIFICATIONS

How can you modify a parachute to change the descent time?

What are we testing?

Independent Variable (this is what you are changing): The modification of the parachute.

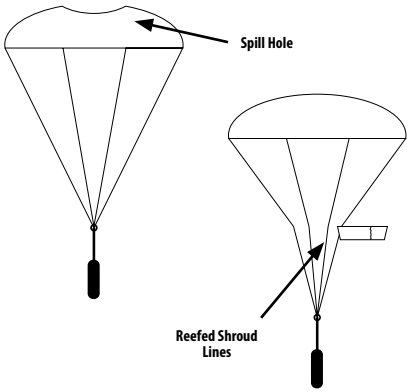
Dependent Variable (this is what you are measuring): Descent Time

Use the tips below to modify your parachute and then test it to see if it speeds up the descent or slows it down.

- **Reef the shroud lines:** tape the parachute strings together to limit how much the parachute can open.
- **Cut a spill hole** in the center of the parachute to allow more air to pass through the chute.
- **Dust baby powder** on the parachute to reduce friction and make it open faster.

Directions:

1. Make the desired changes to the parachute.
2. Attach the parachute to the nose cone. Add recovery wadding and a new engine.
3. Launch the rocket with an adult.
4. As soon as the rocket reaches its apogee, or highest point, start a timer. Stop the timer once the rocket touches the ground.
5. Record your results in the table below. Check the boxes for the modifications that you made. Record the descent time.
6. Make another modification and try again!



Trial	No Change	Cut Spill Hole	Reef shroud lines	Dust with powder	Descent time
1					
2					
3					

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THE PERFECT COMBINATION

It is time to put all the pieces of the puzzle together in a final launch!

Use your collected data to test the combination of equipment and modifications that will best accomplish your mission.

Starting point: Earth

Destination: Mars

Payload: Plant Saplings

Material List: zip-top plastic bag, paper towel, water, a few dry lima beans, tape

Directions:

1. Prepare your payload!
   - Wet the paper towel – Dampen it with water (not soaking).
   - Fold and place – Fold the paper towel and put it inside the bag.
   - Add the bean – Slip 1-2 lima beans between the towel and the side of the bag so it's visible.
   - Seal and tape – Zip the bag shut and tape it to a sunny window.
   - Observe – Check daily! In a few days, the seeds will sprout roots and then little green shoots.
     Extension: Have a "control" sapling that you do not launch for comparison.
2. Add your sapling payload. Protect with paper towel for extra safety.
3. Attach the parachute to the nose cone of the rocket. Add recovery wadding and close the nose cone. Add a new engine.
4. Launch the rocket with an adult.
5. Record your observations below.
   Did you accomplish your mission?
6. Did the rocket perform as expected? What changes, if any, would you make next time?

Sapling Data:

What do you notice each day?

Where do you see the root? Where's the stem?

Why do you think the seed needs water and sunlight?

Record Launch Data	Yes	No
Did this launch have the quickest Descent?		
Was your payload intact upon recovery?		

Extension: Return your sapling to its window nursery. After the sprout grows a few inches, transplant it into soil and watch it become a bigger plant.

Plant the launched sapling next to your "control" sapling. Did one grow better than the other? Why might that be?

SOCIAL MEDIA STAR!

Now it's time to get creative! Come up with a video for social media that illustrates something cool you learned from this mission. It could be facts about Mars, how we can use Mars as a resource, or how rockets can help us explore new places - it's up to you!

Check out these facts below to find out more about Mars resources and get some inspiration for your video.

DID YOU KNOW...

- Mars is the seventh largest planet and the fourth planet from the Sun.
- Mars is one of the easiest planets to spot in the sky - it looks like a bright red spot!
- Mars looks red because iron minerals on its surface have rusted, or oxidized.
- Scientists are searching for signs of life from long ago on Mars, back when it was warmer and had water!

ONE MORE THING...

Do you want to get an up close and personal look at Mars? The Library Telescope Program can make this a reality! Check to see if a library near you participates in this program and search for Earth's planetary neighbor!

librarytelescope.org

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You have been a most excellent problem solver! Thank you for your hard work! You never know, we might be calling on you again someday, from a galaxy far, far away…

Need more engines? Order today at:
https://edu.estesrockets.com

To learn more about NASA's Mars Exploration Program visit:
https://mars.nasa.gov