

ROCKET SCIENTIST IN TRAINING



Discover the exciting world of model rocketry, engineering, and space exploration through hands-on STEM challenges inspired by real rocket scientists and aerospace engineers.

Girl Scouts in grades 4-12 will investigate Newton's Laws of Motion, explore how rockets fly, build their own model rocket, and complete a launch mission or rocket stability test.

MATERIALS

By completing these six missions, Girl Scouts will earn their **Estes Rocket Scientist in Training patch**.

Before you get started, you will need to gather a few special supplies:

MISSION #1

- Computer with access to the internet
- Optional: Larger monitor, screen, or projector



MISSION #2

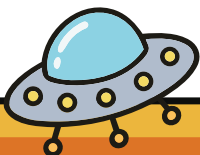
- A small box for items
- Items for *Newton's Laws Discovery Lab*. This can include things like a small and larger toy car, small stuffed animal, dominoes, ping pong balls, tennis balls, balloons, string, tape, index cards, and/or a ruler.

MISSION #3

Girl Scout Troops can create an Educator Account for 20% off all Estes Rockets products here:

[Create an Educator Account](#)

Make sure to visit <https://edu.estesrockets.com/> when you place your order to ensure the discount is applied.



MATERIALS

MISSION #3 (CONT.)

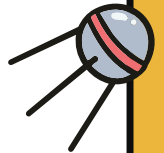
We recommend the following for a Girl Scout troop:

Estes Beginner Rocket –

- [Cosmic Cargo® Bulk Pack \(12 pk\)](#) - A snap-together rocket that only requires clear tape. Cosmic Cargo includes a small payload section - perfect for adding a photo of yourself as an astronaut or writing down a goal or dream for the future to launch with your rocket!

[Watch a step-by-step build video here](#) - The build is nearly identical to Cosmic Cargo, aside from the payload section.

- [\(4\) A8-3 engines \(3 pk\)](#)
- [Recovery Wadding](#)
- [Porta-Pad® II Launch Pad and Electron Beam® Launch Controller](#)



- OR -

- [Firecrest™ Bulk Pack \(12 pk\)](#) - Scissors, yellow glue, plastic cement, and clear tape for the build.
- [1/4A3-3T Engine Bulk Pack \(24 pk\)](#)
- [Porta-Pad® II Launch Pad and Electron Beam® Launch Controller](#)

For Girl Scout Juliettes, we recommend –

- [Mini Alpha™ Starter Set](#) - Everything you need to launch in one kit!



MATERIALS

MISSION #4

- 8 -12 foot piece of string (1 - 2 mm cotton or nylon twine works well for this)
- Safety goggles
- Clear tape or masking tape

MISSION #5

- Pitcher/bucket of water for safety
- Optional: Extra batteries

MISSION #6

- Printed trading card or infographic template (pages 17 - 18)
* **Leader Tip:** Cut out and tape the trading card's front & back sides to each other.
- Pen / pencil
- Markers / colored pencils

PROGRAM GOALS

- Understand Newton's Three Laws of Motion
- Explore how rockets fly
- Learn basic rocket engineering concepts
- Build and test a beginner model rocket
- Connect STEM concepts to real-world aerospace careers

MISSION 1

ROCKET SCIENCE VIDEO BRIEFING

Watch –

[Estes Education Mission: Rocket Science - Newton's Laws](#)
video on YouTube.

After watching, discuss as a group how Newton's Laws apply to model rockets during launch and flight.

1. How does Newton's 1st Law apply before launch?
2. How does engine thrust relate to Newton's 2nd Law?
3. What is the action and reaction during rocket launch?
4. Why is stability important during flight?

Now that we have a basic understanding of Newton's Three Laws of Motion, we will put them into practice.

MISSION 2

NEWTON'S LAWS DISCOVERY LAB

Girl Scouts will work in teams or on their own to investigate Newton's Laws of Motion using a mystery box of household and toy items.

Teams must create demonstrations that show each of Newton's Laws using the items and explain how the law connects to rockets and spaceflight.

Suggested Materials:

- Small and larger toy car
- Small stuffed animal
- Dominoes
- Ping pong balls
- Tennis balls
- Balloons
- String
- Tape
- Index cards
- Ruler
- A small box for items

MISSION 2

CHALLENGE IDEAS

NEWTON'S 1ST LAW –

Demonstrate: An object at rest stays at rest, and an object in motion stays in motion unless acted on by an outside force.

Example: A toy car stops when it hits another object.

NEWTON'S 2ND LAW –

Demonstrate: "Force equals mass times acceleration ($F = ma$)."
The force applied on an object is equal to the product of its mass and acceleration.

Example: The harder you roll a tennis ball, the faster it moves across the ground.

NEWTON'S 3RD LAW –

Demonstrate: For every action, there is an equal and opposite reaction.

Example: When you bounce a tennis ball off the ground, the ground pushes back on the ball and sends it into the air.

MISSION 3

BUILD YOUR ROCKET

Girl Scouts will build a beginner Estes model rocket by carefully following the instructions. They should identify important rocket parts such as:

Nose Cone: The pointed top of the rocket that helps it move smoothly through the air.

Body Tube: The main frame for the rocket.

Fins: Flat parts at the bottom of the rocket that help keep it flying straight.

Engine: Contains propellant to give the rocket power (thrust) to lift off the launch pad.

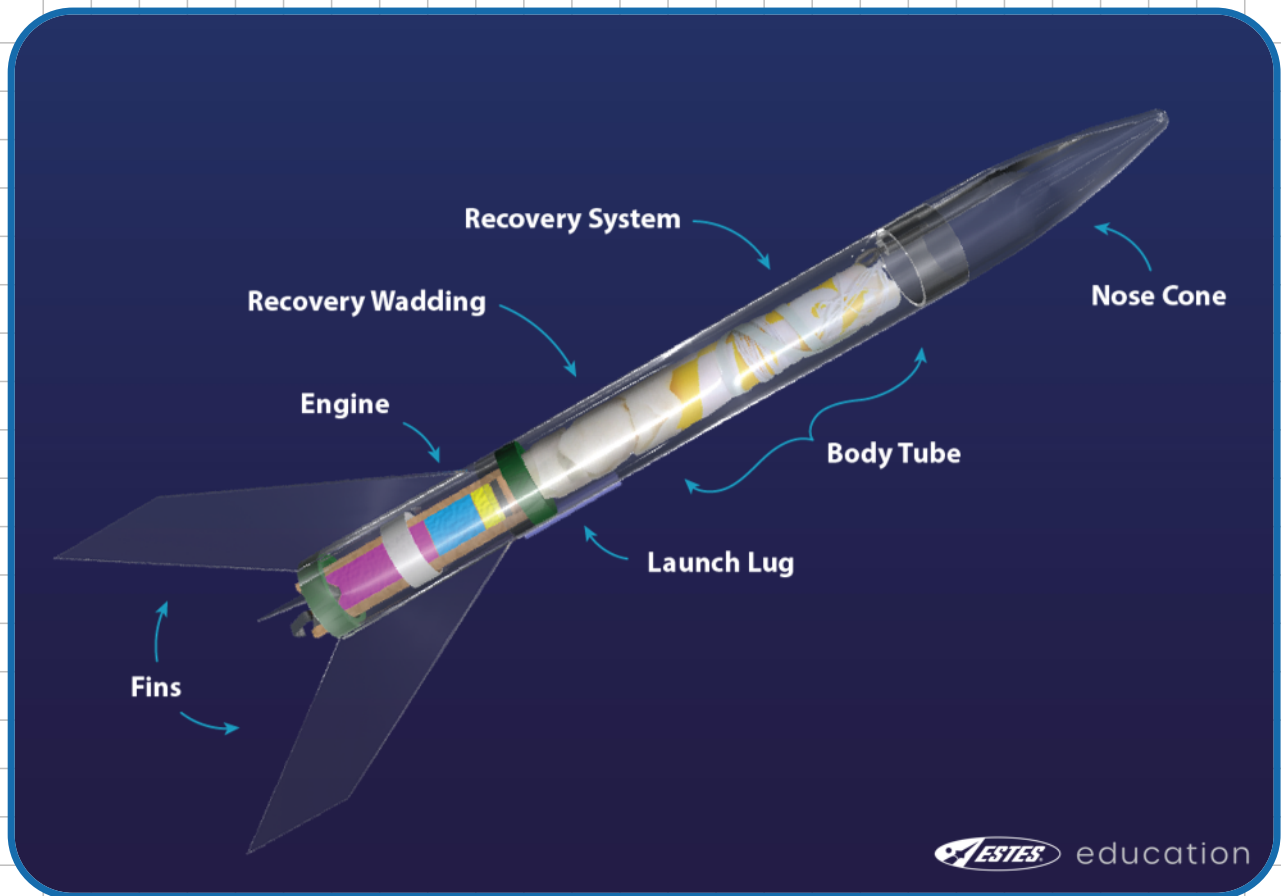
Recovery System (Parachute or Streamer): Helps slow descent, so the rocket lands safely.

Recovery Wadding: A material inside the body tube that protects the recovery system from the engine's heat.

Launch Lug: A small, hollow tube that slides over the launch rod for a straight liftoff.

MISSION 3

ROCKET DIAGRAM



MISSION 4

ROCKET STABILITY TEST

If Girl Scouts are unable to launch their rockets due to weather, field restrictions such as fire restrictions, or scheduling, they can complete the rocket swing test to evaluate rocket stability **in place of** the rocket launch.

This mission teaches important rocketry concepts, so please complete it in any case!

Watch the [Estes Education How to Do a Model Rocket Swing Test](#) video on YouTube.

SWING TEST PROCEDURE

1. Make sure the recovery wadding, recovery system, and engine are inserted in the rocket.
2. Determine the center of gravity (CG) first. Tie the end of a long string (8 -12 feet) around the body tube of the rocket where you think it might balance. When the rocket is balanced it should hang perfectly straight horizontally.
3. Once the string is securely attached, hold it still and allow the rocket to dangle from the string. Hold the string as steady as you can.
4. Does it balance? You may need to adjust the location of the string a few times - that's okay.
5. When the rocket is balanced, the string's location is the CG. Label this on the rocket with the correct abbreviation.

MISSION 4

SWING TEST PROCEDURE (CONT.)

6. Tape the string in place.
7. Put on safety goggles and advance to an open testing area.
8. Check your surroundings! Make sure you are in an open area where your rocket cannot accidentally hit a person or object. Then, gently swing the rocket slowly in a circular motion around your head - like a lasso. Begin slowly with a short amount of string. Slowly release the rest of the string, but do not let go!
9. If during the test the nose points forward (in the direction of the rotation), the rocket is stable. If the rocket sways, or the tail points forward, the rocket is unstable. It might be helpful to record video of your test to analyze.
10. Discuss as a group:
 - Why is it important for your rocket nose to point forward and your rocket to be balanced?
 - If your rocket was unstable, what might happen if you were to launch it?

If your rocket was unbalanced, review the rocket instructions and determine if any steps were missed or done incorrectly.

If you have any issues, please reach out to educator@estesrockets.com for additional assistance.

MISSION 5

LAUNCH DAY

Girl Scouts will safely launch their model rockets and observe rocket flight characteristics.

- Watch the [Estes Education How to Install the Starter](#) video on YouTube for extra launch day support and what to do in case of a misfire.
- Before launching, please review the National Association of Rocketry (NAR) Safety Code:

Materials

- Only use materials provided in the rocket kit.
- Do not tamper with rocket engines in any way.
- Have water for safety and extra batteries for launch controller nearby.

Launch Site

- Launch in an open outdoor area (A engines = field at least 100 ft across; B = 200 ft; C = 400 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.

MISSION 5

LAUNCH DAY (CONT.)

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.

You can find the National Association of Rocketry (NAR) Model Rocket Safety Code [here](#).

MISSION 5

ROCKET FLIGHT OBSERVATIONS

Recording rocket flight data helps scientists and engineers understand what happens during each stage of a rocket's flight and what factors can affect it. They can also compare data from multiple launches to better understand how model rockets perform under different conditions.

1	ROCKET STABILITY DURING ASCENT	
2	RECOVERY SYSTEM DEPLOYMENT	
3	LANDING LOCATION	
4	WEATHER CONDITIONS	
5	ADDITIONAL FLIGHT OBSERVATIONS	

MISSION 6

AEROSPACE SPOTLIGHT

Choose ONE woman in aerospace **OR** ONE aerospace career and create a trading card or infographic. Templates can be printed from pages 17 and 18.

Women in Aerospace –

- **Eileen Collins** - First female Space Shuttle commander
- **Christina Koch** - NASA astronaut
- **Jessica Watkins** - NASA astronaut and geologist
- **Sian Proctor** - SpaceX astronaut and mission pilot for SpaceX Inspiration4
- **Dottie Metcalf-Lindenburger** - Teacher, geologist, NASA astronaut
- **Barbara Morgan** - Teacher, NASA astronaut
- **Lt. Gen. Susan Helms** - Air Force Space Command, NASA astronaut

Include:

- What is she known for?
- What achievement made her a pioneer or leader?
- What skills or qualities helped her succeed?
- What can you learn from her example?

MISSION 6

AEROSPACE SPOTLIGHT (CONT.)

Aerospace Career Connections –

- Aerospace Engineer
- Rocket Scientist
- Astronaut
- Flight Director
- Mechanical Engineer

Include:

- What does this career do?
- What skills are important for this job?
- What is one exciting project or task someone in this career might do?
- What interests you most about this career?

*Printable templates on next two pages

AEROSPACE TRADING CARD	AEROSPACE TRADING CARD
DRAW OR ADD AN IMAGE NAME / CAREER:	SKILLS OR QUALITIES THAT MATTER:
WHAT IS SHE KNOWN FOR / WHAT DOES THIS CAREER DO?	WHAT I LEARNED / WHAT INTERESTS ME MOST:
PIONEER ACHIEVEMENT / EXCITING PROJECT OR TASK:	
WOMEN & CAREERS IN AEROSPACE	WOMEN & CAREERS IN AEROSPACE

17

Use words, drawings, symbols, and color to teach someone about your woman in aerospace OR aerospace career.

AEROSPACE

INFOGRAPHIC

1 TOPIC: _____

2 DRAW IMAGE OR ICON

3 WHAT THEY DO / ARE KNOWN FOR:

Describe the person or career in your own words:

4 ACHIEVEMENT / EXCITING WORK:

Share a pioneering achievement or an exciting project or task: _____

5 SKILLS & QUALITIES:

6 MY TAKEAWAY:

7 MAKE IT YOUR OWN Add a favorite fact, quote, symbol, mini timeline, diagram, or drawing in the space below:



WOMEN & CAREERS IN AEROSPACE

When finished, share your infographic with your troop, a family member, or someone in your community.

CONGRATULATIONS!



You completed the **Estes Rocket Scientist in Training Patch Program**. You explored the principles of physics, learned how rockets fly, practiced engineering skills, and completed a real model rocket mission. [Click here to request your FREE Estes Rocket Scientist in Training patch!](#)

Continue exploring STEM, aerospace engineering, and space exploration with Estes Education! [Discover more here](#)

Learn more about how Girl Scouts can get involved with the American Rocketry Challenge here: [Rocketry Toolkit for Councils and Troops](#)

