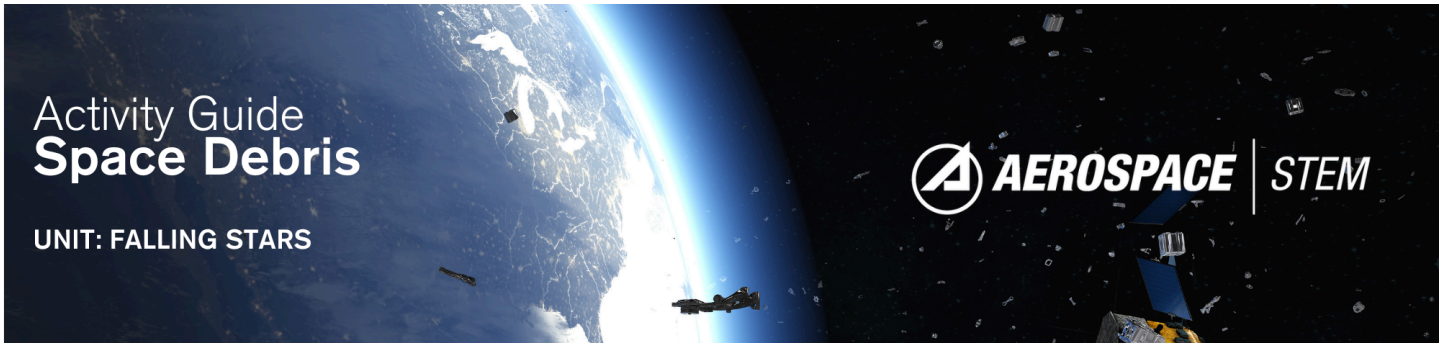

Space Debris Activity Guide

Students will learn about space debris through interactive activities, and discover strategies to both clean up existing debris and prevent future debris from accumulating.

Careers Highlighted	Materials
• Ground Control Operator • Robotics Engineering • Satellite Systems Engineering	All activities • Painter's tape • Timer Activities 1 & 2 • Ball pit balls/tennis balls (at least 50) • Laundry basket • Scooter board (enough for half the students) • Small buckets or bowls Activity 3 • Bubbles/bubble maker • Construction paper • Popsicle stick Activity 4 • Blindfolds (enough for half the students) • Bubbles/bubble maker • Construction paper • Popsicle stick
Grade Level	**Time for Activity**
• Middle school (grade 6-8)	• 30-40 minutes

Activity #1

Setup

- Use painter's tape to create a wide circle, at least 10 yards in diameter.
- Place a laundry basket upside down in the center of the circle with ball pit balls or tennis balls underneath. Use a piece of cardboard to carefully flip the basket over, then slide the cardboard out to keep the balls contained inside.
- One student will be selected as the "space debris creator." This student will stand in the center of the circle, next to the laundry basket.
- 3-4 students at a time will act as "satellites" and will be given roller scooters.

Space Debris Hazard Demo

- Once the space debris creator removes the laundry basket and sets the balls in motion, the "satellites" will continue to try to move around in the circle and stay away from the balls ("space debris"). If a student is hit by the space debris, they are out and will move to the outside of the circle.
- After 60 seconds, reset the mission and rotate a new group of students to take turns becoming the "satellite."
- Ask students to consider:
    - What is space debris? *Leftover material from human-made objects in space*
    - Where does it come from? *Old satellites, spent rockets, fragments from collisions or explosions, satellite breakups, and discarded equipment*
    - What is the risk that space debris poses? *It can collide with satellites or spacecraft, causing damage and making space travel more dangerous.*

Activity #2

Setup

- Use painter's tape to create a wide circle, at least 10 yards in diameter.
- Place a laundry basket upside down in the center of the circle with ball pit balls or tennis balls underneath. Use a piece of cardboard to carefully flip the basket over, then slide the cardboard out to keep the balls contained inside.
- One student will be selected as the "space debris creator." This student will stand in the center of the circle, next to the laundry basket.
- Remaining students will pair up, with one student acting as the "clean up satellite" and the other student operating as the "control system."
- Each pair will stand on the outside of the painter's tape circle. The "clean up satellite" will lay with their chest on the scooter board while the "control system" holds the clean up satellite's legs. Let the pairs practice safely moving forward and backward on the scooters.

Space Debris Cleanup Challenge Demo

- Each "clean up satellite" will have a small bucket or bowl to scoop up the balls. When given the signal, the "space debris creator" will remove the laundry basket and release the ball pit balls into the room. The "control systems" will then move the "clean up satellites" into the center of the circle to begin cleaning the debris. If all balls have not been collected after 60 seconds, or any "clean up satellite" collides with another, the mission is incomplete.
- Ask students to consider:
    - Why is space debris so difficult to clean up? *It is spread over a very large area, and is very challenging to catch.*
    - What is the best way that humanity can minimize the amount of space debris in the future? *Strive to reduce the amount of space debris that we send up in the future to prevent ourselves from having to clean it up at all.*

Activity #3

Setup

- Use painter's tape to create a circle at least 10 yards in diameter.
- One student will be selected as the "space debris creator." This student will stand in the center of the circle, either preparing to blow bubbles or turn on the bubble machine.
- Remaining students are all assigned as "clean up satellites," and will hold a popsicle stick with a piece of construction paper attached to it.

Three-Dimensional Space Debris Cleanup Challenge Demo

- When instructed to do so, the "clean up satellites" will enter the circle and attempt to pop all of the bubbles produced before they are out of reach. After 60 seconds, if no bubbles remain unpopped, the mission has been completed successfully.
- Ask students to consider:
    - Why is space debris more difficult to clean up than ocean debris? *Because space debris is traveling at different velocities and is not confined to a two-dimensional plane.*

Activity #4

Setup

- Use painter's tape to create a circle at least 10 yards in diameter.
- One student will be selected as the "space debris creator." This student will stand in the center of the circle, either preparing to blow bubbles or turn on the bubble machine.
- Remaining students will pair up, with one student acting as the "clean up satellite" and the other student operating as the "control system."
- Each pair will stand on the outside of the circle. The "clean up satellite" will be blindfolded and will hold a popsicle stick with a piece of construction paper attached to it.
- The "control system" stands outside the circle giving orders to the "clean up satellite." Students will be reminded to move slowly and methodically to ensure not to injure each other during the demonstration. *Teacher Note: It is important to have a small group (2-3) inside the circle at the same time for safety.*

Satellite Communication Cleanup Demo

- When instructed to do so, the "clean up satellites" will enter the circle and follow instructions from their respective "control systems" and attempt to pop all of the bubbles produced before they are out of reach without running into any other satellites. After 60 seconds, if no bubbles remain unpopped, the mission has been completed successfully.
- Ask students to consider:
    - Why is using satellites to clean up space debris more challenging? *Due to communication difficulties between Earth and satellites.*

Explore More!

Laser Communications Activity Guide
Falling Stars Lesson Plan