



## **Cosmic Cleanup Lesson Plan: Small Items | Big Impacts**

### **Location of “Cosmic Cleanup”**

Gateway to Space

### **Overview of “Cosmic Cleanup”**

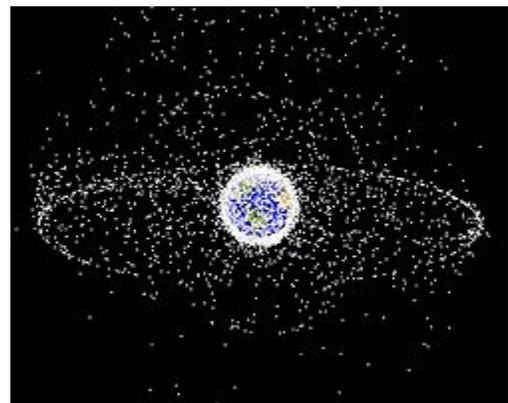
Cosmic Cleanup is an interactive game on a stationary kiosk. It depicts the serious and growing problem of space debris in a fun and engaging way. As the player, you must maneuver the space craft to collect small space junk while dodging asteroids and other space craft which can destroy your craft. If successful, you are awarded a badge.

### **Lesson Overview**

This lesson plan/unit could be used independently or to prepare for (or to extend the learning after) a visit to Spaceport America. It can be used by teachers or parents wishing to make the Spaceport visit a richer learning experience (for everyone!).

First, why is cleaning up the cosmos important? Meteoroids (natural metallic or rocklike bodies traveling in space) range from as small as a grain of sand up to a meter in diameter. Moving at very fast speeds, they can wreak havoc on man-made satellites and other space craft orbiting Earth. However, compared to the amount of human-made space junk, meteoroids are a relatively small threat.

Scientists at the *Stockholm International Peace Research Institute* estimate that upwards of 370,000 pieces of space junk are currently around Earth low orbiting at tremendous speeds. The debris is made up of everything from paint chips to tiny screws and bolts to large parts of rockets and old satellites. Around 17,000 objects larger than a softball are currently being tracked because they pose great threat of collision with satellites and space craft as they orbit Earth. Many have leftover fuel and could explode at any time, increasing the amount of debris. This growing mass of space junk has led the international community to begin thinking about ways to clean it up.



*Orbital Debris being tracked by NASA. (See [Orbital Debris Graphics](#) in Other Resources.)*



One proposed solution from Japan is a kind of giant fish net that would capture space junk much like the *Cosmic Cleanup* game suggests. NASA has proposed a laser that would zap debris out of existence or slow it down so that it falls back to Earth and burns up in our atmosphere. The European Space Agency is proposing multiple designs of space craft with tentacles, harpoons, and robotic arms to retrieve the debris.

In this brief hands-on experiment, students will use a fast moving object (their own hand holding a straw) to hit another object (a raw potato) to demonstrate the damage space junk can cause on satellites and space craft.

### **Grade Level**

Grades 3 and up. (For safety reasons, this experiment may best be *demonstrated* to younger students.) See “Other Resources” at the end of this document for a link to an additional lesson for high school students.

### **Learning Objectives**

1. Students will be able to describe how even very small space debris can cause major damage to spacecraft.

### **Assessment**

Each student will write a description of the experiment they performed along with their results and conclusions. As an extension activity, you may wish to require them to draw or write a description of their own solution for cleaning up space debris to share with the class.

### **Required Materials**

- Raw potatoes (long rather than round potatoes work best)
- Plastic straws of large diameter

### **Time Required**

One class period.

### **Step-By-Step Procedures:**

1. Introduce the topic by telling/reminding students about the *Cosmic Cleanup* game.
2. Share some of the facts about space debris found in the Lesson Overview. Older students can research “space debris” or “space junk” using the Internet or other reference materials to learn on their own.
3. Divide the class into small groups. Pass out a potato and a straw to each group.

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4. Instruct the students to hold a raw potato in one hand. (They should hold the potato on one end so that the other end is clear of their hand.) Caution: Do NOT allow one student to hold the potato while another uses the straw! Tell the students that each one in the group will take turns performing the experiment.
  5. While grasping the straw with the other hand, tell them to raise it and stab the potato with a quick, sharp motion. The straw should penetrate completely through the potato.
  6. Next, repeat the process, but this time, stab the potato slowly. The straw should bend.
  7. Ask the students to write a description of their experiment along with the results and their conclusions.
  8. Relate this to space debris. Discuss the damage a fast moving object could do to a stationary or slower moving object in space. Ask what slowing down the objects might have on their ability to cause damage.
  9. Allow the students to draw (and/or describe in writing) their own solution for cleaning up space.

### ***Alignment to Common Core Standards***

The Common Core asks students to read stories and literature, as well as more complex texts that provide facts and background knowledge in areas such as science and social studies. Students will be challenged and asked questions that push them to refer back to what they've read. This stresses critical-thinking, problem-solving, and analytical skills that are required for success in college, career, and life. (<http://www.corestandards.org/ELA-Literacy/>)

The Science and Technical standards begin at grade 6; standards for K-5 reading in history/social studies, science, and technical subjects are integrated into the K-5 Reading standards. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations—the former providing broad standards, the latter providing additional specificity.

Next Generation Science Standards also align well with this lesson. Specifically, ESS3.C: Human Impacts on Earth Systems. Typically, when we think about Earth, we do not consider the space surrounding it. This lesson signifies why perhaps we should.

### ***Other Resources:***

- **Modeling Orbital Debris Problems** – In this lesson plan for grades 9-12, students examine the problem of space pollution caused by human-made debris in orbit to develop an understanding of functions and modeling. It allows the students an opportunity to use spreadsheets, graphing calculators, and computer graphing utilities. <http://illuminations.nctm.org/Lesson.aspx?id=1386>

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- **Japan's plan to collect space garbage with... a giant fishing net?** – <http://theweek.com/article/index/211844/japans-plan-to-collect-space-garbage-with-a-giant-fishing-net>
  - **NASA's Plan to Clean Up Space Junk: Lasers** – <http://theweek.com/article/index/213197/nasas-plan-to-clean-up-space-junk-lasers>
  - **How to Catch a Satellite** – [http://www.esa.int/Our\\_Activities/Space\\_Engineering/Clean\\_Space/How\\_to\\_catch\\_a\\_satellite](http://www.esa.int/Our_Activities/Space_Engineering/Clean_Space/How_to_catch_a_satellite)
  - **Orbital Debris Graphics** – The graphics found at the following link are computer generated images of objects in Earth orbit that are currently being tracked. Approximately 95% of the objects in the illustrations are orbital debris, i.e., not functional satellites. The dots represent the current location of each item. The orbital debris dots are scaled according to the image size of the graphic to optimize their visibility and are not scaled to Earth. These images provide a good visualization of where the greatest orbital debris populations exist. The graphics are generated from different observation points. <http://orbitaldebris.jsc.nasa.gov/photogallery/beehives.html>