The University of Texas at Austin
Environmental Science Institute

# Exploring Space Junk

**Lesson Plan for Grades:** Middle School 6-8
**Length of Lesson:** 60 min

**Authored by:** UT Environmental Science Institute
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**Subject area/course:**

- General Science, Environmental Science

**Materials:**

- *Exploring Space Junk Packet* (attached)
- Dice (6 sided)
- Colored Pencils
- Coins or Small Objects (1 per student to be used in Exploration)
- Projector or Classroom Video Monitor
- AstriaGraph http://astria.tacc.utexas.edu/AstriaGraph/ (Elaboration Resource)

**TEKS/SEs:**

**§112.50. Environmental Systems, Adopted 2021**

(11) Science concepts. The student understands how individual and collective actions impact environmental systems. The student is expected to:

- (A) evaluate the negative effects of human activities on the environment, including overhunting, overfishing, ecotourism, all-terrain vehicles, and personal watercraft;

**§112.18. Science, Grade 6, Adopted 2017.**

(11) Earth and space. The student understands the organization of our solar system and the relationships among the various bodies that comprise it. The student is expected to:

- (C) describe the history and future of space exploration, including the types of equipment and transportation needed for space travel

**Lesson objective(s):**

- Students will be able to define space pollution, its origins, and relevance to the future of space travel
- Students will be able to describe the consequences of increased volumes of pollution in space
- Students will be able to suggest methods to make space travel more sustainable

**Differentiation strategies to meet diverse learner needs:**

- The teacher should ask students whether they prefer to read or watch videos to learn about concepts; then have students learn in their preferred learning style. However, the teacher may assign students certain methods to improve their skills. For example, if a student prefers reading, teachers may have them watch a video and take notes to improve their listening skills.

- ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as a verbal instruction and demonstration.

**ENGAGEMENT (10 minutes)**

- The teacher will begin the lesson by playing part of the *Hot Science at Home "*Space Environmentalism" video from 43:23 to 44:20 at https://youtu.be/2xu5wS2dNlE.
- Students will engage in a think-pair-share. Students will first be given 2 minutes to independently reflect on the video and think of a working definition for space environmentalism. Students will then group into teams of two. Once paired, groups will have five minutes to discuss what they thought about the video, what they defined "space environmentalism" to be, and what they think could be considered "space junk".
- The teacher will ask a couple groups to share what their working definition for "space environmentalism", pointing out some similarities and differences between different group's definitions.

**EXPLORATION (30 minutes)**

- Students will group up again with their think-pair-share partner. Each group will be given 2 *Exploring Space Junk Packets* (one per student), a six-sided die, and a pack of colored pencils.
- The teacher will explain what the students will be doing during the activity described in the packet, detailing each instructional step, and demonstrating it to provide an example.
- Each group will follow the instructions laid out in the *Exploring Space Junk* packet, working through an interactive activity demonstrating the creation of space junk from colliding satellites and recording correlated data.
- The teacher should continue to walk around the room during exploration, prompting groups to have conversations on the ramifications of increased space junk on their own lives and how their working definition of "space environmentalism" aligns with what they are seeing being created through the simulative activity.

**EXPLANATION (10 minutes)**

- The teacher will ask groups to share what they found during their activity. Prompting questions should focus on reactionary results of changing components of the simulation and overall result. Example probing questions:
  - What happened when there was more space junk on the board? Did we see more collisions? What about more production of space junk as a whole?
  - Why would this simulation be important when thinking about the future of space travel and the advancement of technology on Earth?
- The teacher will summarize the classroom's collective findings and ask, "How much space junk do you think there is as we sit here today?", allowing students to respond with their hypothesized answers and asking if other students agree.

**ELABORATION (10 minutes)**

- The teacher will pull up AstriaGraph (http://astria.tacc.utexas.edu/AstriaGraph/) on the classroom projector or video monitor and ask students to share their initial reaction to seeing how much human made material is in space.
- The teacher will ask probing questions to create a classroom reflection conversation focusing on how this increasing accumulation of "space junk" is affecting and will continue to affect us.
  - How is this graph like the exploration activity we participated in today?
  - When we think about satellites, we often think about them just being active, not about what happens when they no longer are. Why is it important to consider the lifespan and ramifications of increasing amounts of satellites being sent into space?
  - What are ways we could work to be better space environmentalists?
- Students will engage is personal and collective reflection through class discussion.

**EVALUATION (throughout entire lesson)**

- Formative assessment will be performed throughout the lesson. As the students are working in their groups during the Explore stage, the teacher will be walking around assessing the students and the connections they continue to make to the content. The teacher can take note of intriguing connections made by students to bring up during the elaboration section.
- A summative assessment can be implemented at the end of the class, having students write down 3 things they learned and what Space Environmentalism means to them after going through the day's lesson as an exit-ticket activity. Additionally, all materials written on can be collected to assess student learning and overall acquisition of knowledge

**SOURCES AND RESOURCES**

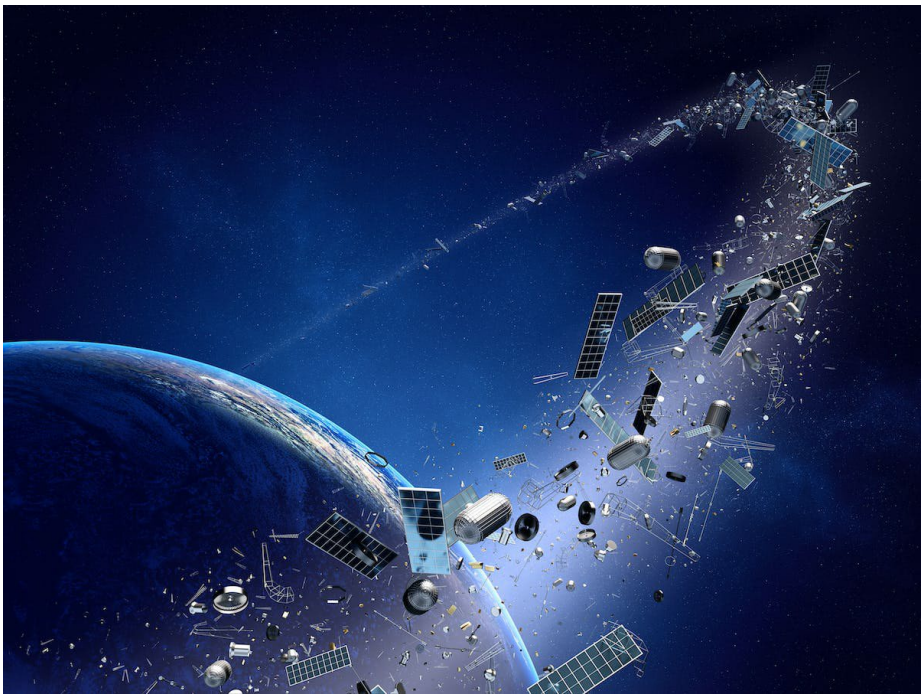

- Dr. Moriba Jah's Hot Science at Home *#1.12,* **"Space Environmentalism",** https://www.youtube.com/watch?v=2xu5wS2dNlE&feature=youtu.be.
- AstriaGraph**,** http://astria.tacc.utexas.edu/AstriaGraph/.

**Exploration - Student Handout**

# Exploring Space Junk

Objective:

As technology continues to advance and humanity begins to set its eyes further to the stars, increased space travel and usage of satellites poses an interesting environmental risk. When devices such as satellites break down, they become “space junk”, and can collide with objects in space. The entire ecosystem can go from a carefully coordinated network to an ever-accumulated footprint of human made pollution. This simulative activity aims to exemplify this “ecosystem” and reflect the ways in which space junk can be created, accumulated, and the balancing act that is dealing with it.



In the following activity you and your partner will be observing your own satellites and surrounding debris as they make carefully planned orbits around Earth. By rolling the die every turn while your satellite moves clockwise in its orbit, you will record newly found information on the location of space junk in near-Earth space. Space junk can be unpredictable, and in this activity if you find out about the location of the junk as soon as your satellite arrives to that sector, of if there is already too much space junk, your satellite may take damage. After three major damage events, other satellites beware because the damaged satellite will become space junk too!

Materials:

- Space Junk Board (see next handout)
- Colored Pencils
- 1, 6-sided Die
- 2 coins

Procedure:

1. Place a coin in a region around the Earth (1 per student). This will represent your very own satellite.

2. Roll the die to see who's turn will be first, whoever rolls the highest will take the first turn.

3. Move your coin one space in the clockwise direction, this represents your satellite continuing its orbit.

4. Roll the die. Draw a circle in the corresponding region representing a piece of space junk. Refer to the following scenarios and follow instructions if it applies to your turn.

   - If your satellite moved into the same region as the space junk you just discovered upon the start of your turn, roll the die again to determine if it took damage. An even number roll will result in no damage while an odd number will result in damage.

   - If your satellite moved into a region that already contains 3 pieces of space junk, roll the die again to determine if it took damage. An even number roll will result in no damage while an odd number will result in damage.

   - If your satellite takes damage, draw another circle in this region. Your satellite will be able to take damage 3 times in total until it will be destroyed and become space junk.

   - If your satellite has now taken damage 3 times in total, it is now destroyed. Draw two circles in the region it was in and remove the coin from the board. Continue observing your partner's satellite.

5. Each student repeat steps 3 & 4 until both student's satellites have been destroyed or until each person has taken 12 turns. (2 full orbits around Earth)

6. Upon finishing Step 5, answer the reflection questions on Page 4.

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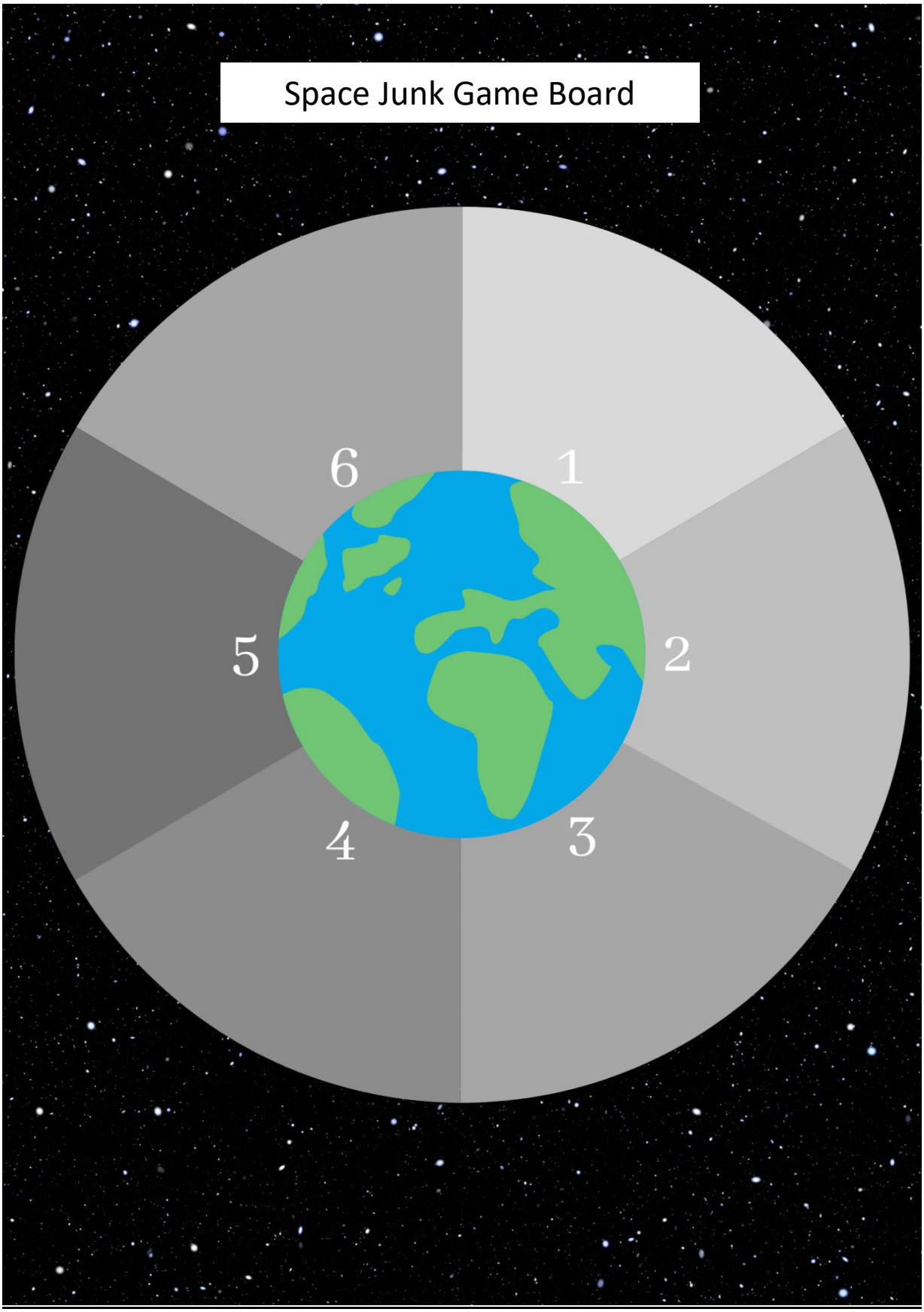
# Space Junk Game Board

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Reflection:

1. Did your satellite make it through 2 full orbits? If not, how many turns were you able to take before it became space junk?

2. If one of the satellites became space junk before the other, did this effect damage taken by the other?

3. While your satellites were on coordinated orbits, the junk you encountered was much more random and harder to account for at times, leaving it up to chance whether your satellite took damage. Why is this important to think about with increasing numbers of satellites and devices being sent to near-Earth space?

4. Cleaning up space junk is not an easy task and for this simulation you were not able to make efforts to do so. Why would it be important to advocate for better efforts to make more sustainable and environmentally friendly space travel and satellites, with this difficulty to immediately remedy space junk?

5. We don't often hear about there being a ton of space junk in near-Earth space, rather just about terrestrial pollution. How much space junk do you think there really is?