Educating Space Age Environmentalists:

A Pre-K-High School Standards-Based Curricular Approach

(Aligned to the 2016 Massachusetts Science and Technology/Engineering Standards for Earth and Space Science)

GRADE 1

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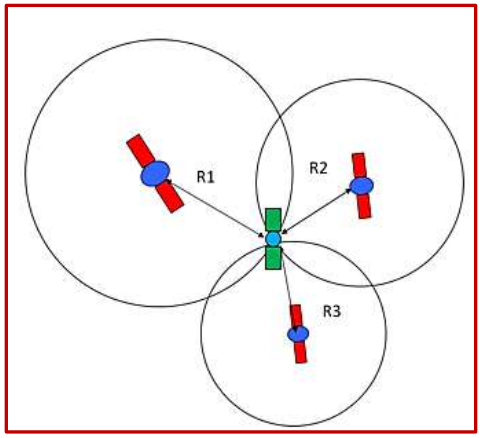
Grade 1

Outer space is a valuable natural resource, serving as home to GPS satellites that provide navigational aid and are instrumental in tracking the movement of migratory birds. To ensure that such GPS satellites can continue to navigate safely, solutions to the threat of space debris must be found.

Students gain an appreciation of the importance of GPS tracking through participating in a lesson entitled "Massive Migrations," aligned with **1-ESS1-2 (Earth's Place in the Universe)**. Students learn that birds come from different parts of North America, and that the length of time it takes migratory birds to reach their destination varies from one species to the next. Students participate in an activity designed to teach them about the three habitat types of migratory birds. They record and compare data on bird migration, and learn about the benefits gained from bird tracking. An excellent pairing of two books (one nonfiction and one fiction) correlate well with this lesson. The nonfiction book is entitled, *How Do Birds Find Their Way?* - by Roma Gans and Paul Mirocha (Book 1 from the "Let's-Read-and-Find-Out Science 2 Series). The fiction book is entitled, *Welcome, Brown Bird*, by Mary Lyn Ray.

Extension 1 materials include a *NASA Space Place* video entitled, "How Does GPS Work?", along with an accompanying downloadable classroom poster. Another video entitled, "How We Know Birds Migrate," is helpful in teaching students about the different methods scientists use to track egret migrations. A picture book memoir by Astronaut Scott Kelly entitled, *My Journey to the Stars*, is also recommended.

Extension 2 features a space debris graphic and an article entitled, "Collision in Space," which serve as the basis for class discussion. Students subsequently write their own opinion pieces about space debris, in alignment with the **Grade 1 Reading, Writing, and Speaking and Listening standards from the *2017 MA English Language Arts and Literacy Framework*.** Students state their opinion as to why this issue is important, backing up their opinion with facts from the article. Students also discuss what a "space junk" cleanup solution might look like. As a culminating activity, students create and share their own "Keep Outer Space Clean" T-shirts.

2016 Massachusetts Science and Technology/Engineering Curriculum Framework Alignment	Spacecraft Featured: *GPS*	NASA Main Page for Featured Spacecraft: Click here for GPS.
Disciplinary Core Idea/Sub-Idea: **ESS1. Earth's Place in the Universe** **Earth and the Solar System (ESS1.B)** Grade 1: Earth and Space Sciences **ESS1. Earth's Place in the Universe** 1-ESS1-2. Analyze provided data to identify relationships among seasonal patterns of change, including relative sunrise and sunset time changes, seasonal temperature and rainfall or snowfall patterns, and seasonal changes to the environment. Clarification Statement: Examples of seasonal changes to the environment can include foliage changes, bird migration, and differences in amount of insect activity.	 **Credit: NASA**	*Global Positioning System or GPS is a United States space-based radio navigation system that helps pinpoint a three-dimensional position to about a meter of accuracy (for example – latitude, longitude, and altitude) and provide nano-second precise time anywhere on Earth. GPS is comprised of three different parts: Space Segment – A constellation of at least 24 U.S. government satellites distributed in six orbital planes inclined 55 degrees from the equator in a Medium Earth Orbit (MEO) at about 20,200 kilometers (12,550 miles) and circling the Earth every 12 hours; Control Segment – Stations on Earth monitoring and maintaining the GPS satellites; and User Segment – Receivers that process the navigation signals from the GPS satellites and calculate position and time.* *-NASA Website*

Lesson Plan (from National Wildlife Federation) recommended by protectouterspace.com

Lesson: "Massive Migrations"

Goal: Students will recognize that birds come from different parts of North America and be able to show that the length of time it takes migratory birds to reach their destination differs.

Lesson Description: This activity guides students through the process of creating a physical simulation of bird migration. Students participate in three stations simulating the three habitat types of migratory birds, including nesting areas, non-nesting areas, and stopover locations. Students record and compare data on the migration of four birds, showing their understanding through written descriptions and/or illustrations of their migratory stops.

For an overview of this resource and the lesson plan as posted on the National Wildlife Federation website, click here.

Extension 1: Outer space is a valuable natural resource, serving as home to spacecraft that provide essential information and perspective for understanding Earth's Place in the Universe, Earth's Systems, and Earth and Human Activity.

Instructional Focus: Global Positioning System satellites provide a more comprehensive understanding of birds' migratory patterns than older tracking technologies.

Two appealing books selected by *protectouterspace.com* are excellent resources for accompanying this lesson – one nonfiction and one fiction – and could be readily paired.

•**Nonfiction Book: Gans, Roma and Paul Mirocha. *How Do Birds Find Their Way?.*** New York: HarperCollins, 1996. Print. ISBN: 978-0064451505. (Let's-Read-and-Find-Out Science 2 Series – Book 1; Recommended by *School Library Journal* for Grades 1-3/Age Range: 4-8 years/Specified Grade Level: Kindergarten-Grade 4/Lexile Measure: 620). From the back of the book: *Birds don't need maps! Many birds make long journeys twice each year as they migrate between their winter and summer homes. Arctic terns fly more than 10,000 miles from the South Pole to northern Maine. Tiny little hummingbirds fly nonstop over the ocean for 500 miles. How do they know which way to fly? Why don't they get lost? Read and find out the many ideas scientists have come up with to explain this mystery.*

•**Fiction Book: Ray, Mary Lyn. *Welcome, Brown Bird.*** New York: Harcourt, 2004. Print. ISBN: 978-0152928636. (Recommended Age Range: 3-7 years). The story is about a wood thrush that makes a long migration between New England and Central America. At each end of the journey, a boy watches and waits, protecting the bird's nesting place until it returns. Although they are not aware of it in the story, both boys share a love of the thrush's song. An author's note provides information on wood thrush migration and habitat protection.

Extension 1 materials include two videos and a nonfiction book.

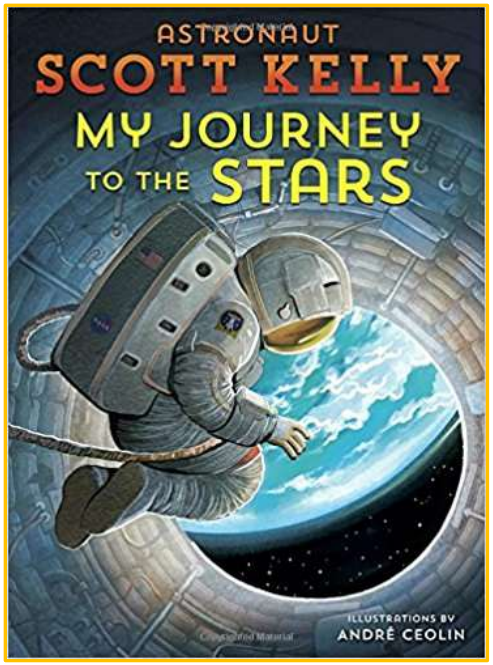
- **Video: *How Does GPS Work?*** - *NASA Space Place* - (3 min.)

This video provides a helpful tool to use in explaining how a Global Positioning System (GPS) can be instrumental in tracking the movement of migratory birds. **Click here** for the video, along with a downloadable classroom poster.

• **Video: *How We Know Birds Migrate*** - *Untamed Science – (4 min.)*

This video describes various methods scientists use to track egret migrations, utilizing GPS tags. Considering that egrets are found in Massachusetts, this video is particularly appealing, and shows how the combined use of GPS and satellites is much better than the old way of tracking birds prior to this technology becoming available. **Click here** for the video.

(Right: From video – "How We Know Birds Migrate" – Researchers from the Pine Island Sanctuary Audubon Center in Corolla, NC attach a GPS tracker to a Great Egret.)



(Right: The GPS tracker used to track the great egret.)

- **Book: Kelly, Scott. *My Journey to the Stars.*** Toronto: Crown Books for Young Readers, 2017. Print. ISBN: 978-1524763770. (Age Range: 5-8 years/Grade Level: Kindergarten – 3). Scott Kelly is a NASA astronaut who commanded the space shuttle endeavor in 2007, twice commanded the International Space Station, and was the first to spend an entire year in space. In this picture book memoir, which makes the perfect companion to his new book on the same topic for adults (*Endurance*), he shares his amazing journey. The book review from *School Library Journal* states that this book will "inspire a new generation of space travelers."

Extension 2: The growing problem of space debris requires us to clean up the space environment – utilizing new technologies and public advocacy – before it becomes too dangerous to navigate.

Instructional Focus: Students write an opinion piece on the issue of space debris in alignment with 2017 ELA standards after reading and discussing a Scholastic article about the 2009 collision of the Iridium 33 and Cosmos 2251 satellites that created over 1000 pieces of trackable debris.

Standards Alignment - ***2017 MA English Language Arts and Literacy Framework:***

Grade 1 Reading Standards for Informational Text [RI]
Key Ideas and Details
1. Ask and answer questions about key details in a text.
2. Identify the main topic and retell key details of a text.

Grade 1 Writing Standards [W]
Text Types and Purposes
1. Write opinion pieces that introduce the topic or name the book they are writing about, state an opinion, supply a reason for the opinion, and provide some sense of closure.
Production and Distribution of Writing
5. With guidance and support from adults, focus on a topic, respond to questions and suggestions from peers, and add details to strengthen writing as needed.
    b. Demonstrate the ability to choose and use appropriate vocabulary.

Grade 1 Speaking and Listening Standards [SL]
Comprehension and Collaboration
1. Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.
a. Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion.)
b. Build on others' talk in conversations by responding to the comments of others through multiple exchanges.

Extension 2 resources feature a space debris graphic, an article, and a writing activity. As a culminating activity, students create and share their own "Keep Outer Space Clean" T-shirts.

1. NASA Space Debris Graphic

Following a discussion about the key role that GPS satellites play in tracking bird migration, show students a NASA space debris graphic. Explain that the little dots/objects represent pieces of space debris that are orbiting continuously around the Earth, and no longer serve a useful purpose; rather, this debris (or "junk") is endangering astronauts and spacecraft due to the risk of collisions. Explain the source of this debris, and provide specific examples, such as: discarded rocket parts, obsolete satellites that no longer work, leftover fuel tanks, old rocket boosters, bolts and screws, paint flecks, and items astronauts have lost out in space – such as tools and gloves.

Emphasize that this space junk must be cleaned up to keep astronauts and spacecraft safe. Compare this to the importance of keeping our environment clean here on Earth. Remind the students that they do this at home by keeping their rooms neat, cleaning up after themselves, and disposing of their trash correctly. Emphasize that it's also important to do this in space. Keeping outer space clean is very important so that astronauts can continue to work safely there, and spacecraft can continue to operate – providing us with important information to keep all living beings healthy and safe. Emphasize with students that space junk can destroy a spacecraft, and that even a paint fleck – traveling at a high rate of speed – can cause damage, as it did to a window in the International Space Station. **Click here** for the graphic. (Additional NASA space debris graphics are found by **clicking here**.)

2. Article: "Collision in Space"

Read with the students an article entitled, "Collision in Space." (Attached) Review with the students the important things that satellites do from space, and why space debris is a threat to these satellites. Discuss the questions accompanying the article with the students.

3. "Space Junk" Cleanup Solutions

Encourage students to share their ideas regarding what a "space junk" cleanup solution might look like. Emphasize to students that scientists and engineers are currently considering many different ideas for space junk cleanup, and that perhaps in the future, they may want to become aerospace engineers and design space debris solutions to help solve this problem.

4. Writing Activity – Opinion Piece

Have students write an opinion piece on space debris, stating what their opinion is on this subject, and backing up their thoughts with information from the article as well as their suggestions for possible solutions.

5. Design a "Keep Outer Space Clean" T-Shirt

As a fun culminating activity, have each child design his/her own “Keep Outer Space Clean” T-shirt with a message about the importance of cleaning up space junk. Materials needed for this project: a T-shirt template for each student (see appendix), pencils, crayons, markers, scissors, and rulers. Prior to designing their T-shirts, it would be beneficial for students to have time – either as a class or working in small groups – to brainstorm ideas for their T-shirt.

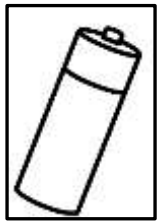
Directions:

1. Have students trace the T-shirt template onto card stock, and then cut out the T-shirt shape. If desired, students could cut out two shapes so they could design both the front and the back of their shirt.
2. Prior to designing their T-shirts, have students work in small groups to brainstorm ideas for an important idea or slogan they would like to use to illustrate their T-shirt. (Examples might be: “Keep Outer Space Clean,” “Clean Up Space Junk Now,” “No More Space Junk,” etc.) If desired, distribute the space debris cutout page (attached) for the students to use in creating their T-shirt design. Encourage the students to incorporate into their design their idea of what a “space junk” cleanup solution might look like.
3. Have them draw their design in pencil, and then color it with markers or crayons.
4. Have students present their T-shirt designs to the class, explaining why they chose their slogan and design. Display the T-shirts hung on a clothesline for an attractive classroom display! As an alternative, students could create an electronic version of their T-shirt using a computer or other electronic device.

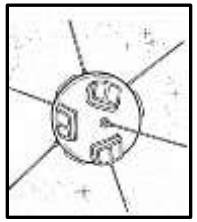
Space Debris Cutout Page

Paint Flecks

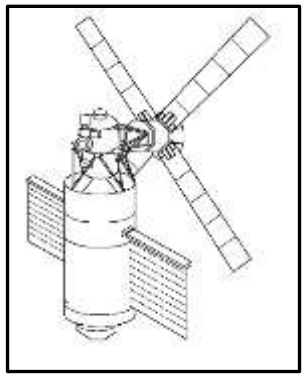
Old Battery



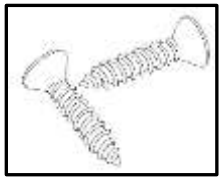
Explorer 1 Satellite Launched in 1958



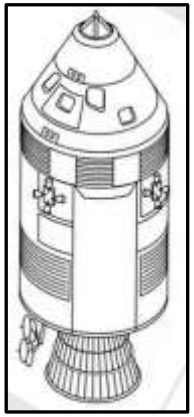
Old Satellite



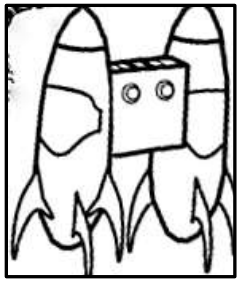
Screws



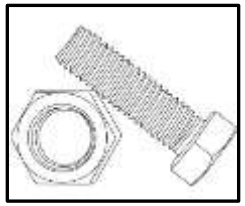
Discarded Rocket



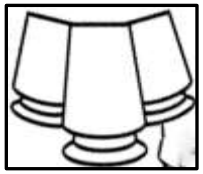
Leftover Fuel Tanks



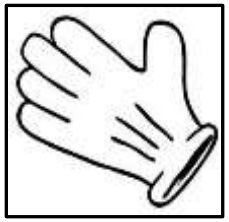
Nuts and Bolts



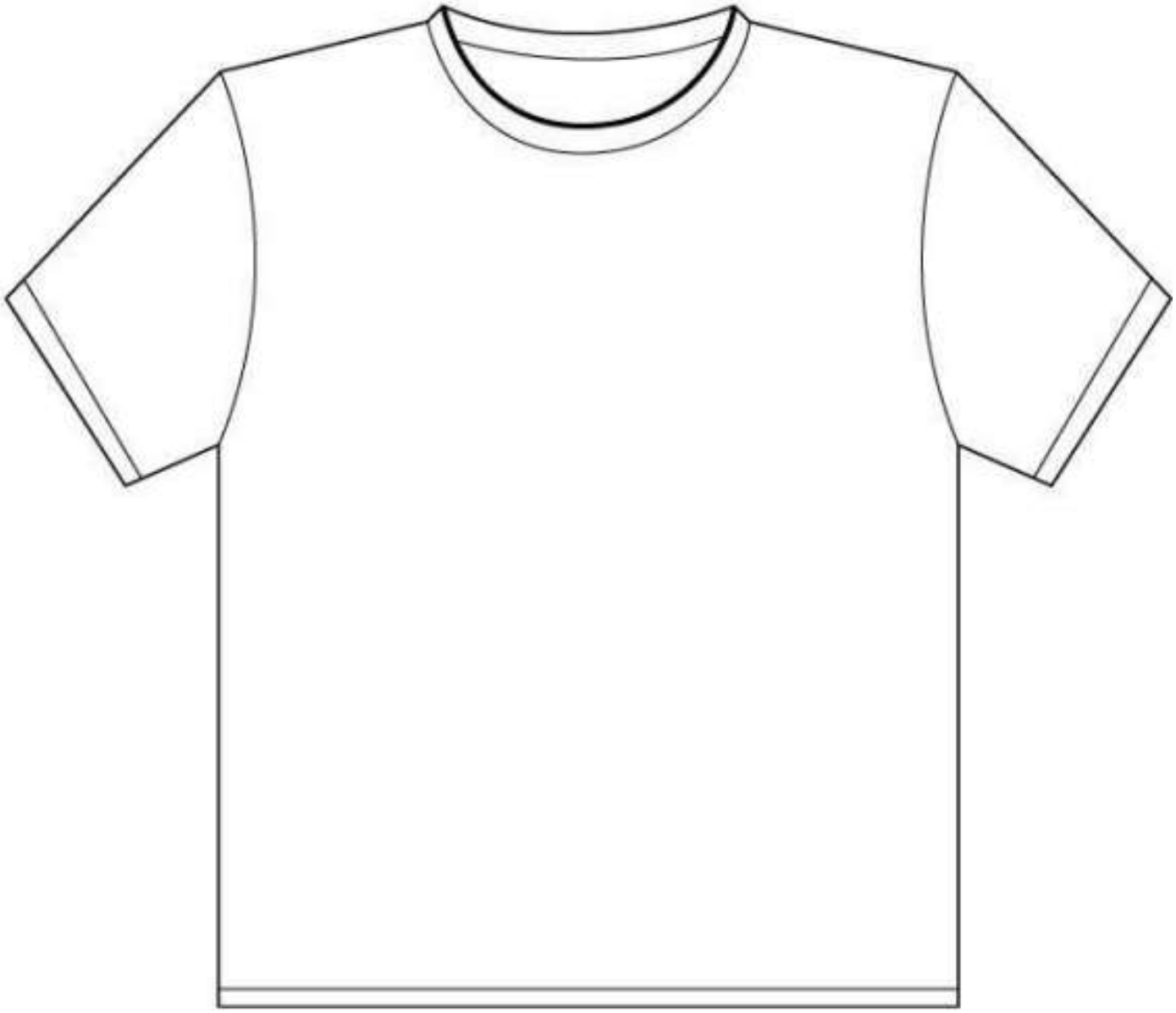
Old Rocket Booster



Glove



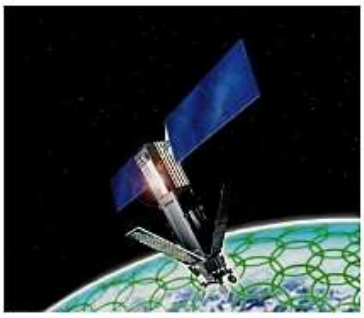
T-Shirt Template



Collision in Space

(This article, originally written by Dante A. Ciampaglia and published by Scholastic News Online in Feb. 2009, was updated and revised by protectouterspace.com editors in 2017.)

Earthlings take a closer look at the space junk circling the planet after two satellites crash into each other.



Iridium 33

Cosmos 2251

The area around the Earth is a very crowded place. There are thousands of human-made satellites in Earth's orbit. Some of these objects collect scientific data about what's happening in outer space. Others research Earth's air and oceans. And some allow humans to use gadgets like cell phones and computers.

On Feb. 10, 2009, 485 miles above Earth, two of those satellites collided. The American Iridium 33 communications satellite and an old Russian satellite, Kosmos-2251, were circling Earth at a speed of 25,200 miles per hour (mph). When their paths crossed, they smashed into each other and sent a cloud of debris into Earth's orbit.

Humans have been sending satellites into orbit since 1957. This was the first time two satellites crashed into each other.

Scientists say the collision occurred in a low orbit around Earth that is especially crowded. There are a lot of satellites in this region. There are also bigger objects. The Hubble Space Telescope is about 372 miles above Earth. The International Space Station is in orbit 220 miles above Earth. Shuttle missions usually take place here too.

But it's the small stuff crowding Earth's orbit that has scientists concerned.

There are millions of pieces of space junk circling Earth. Every time a space shuttle or satellite or space station is sent into space, humans leave a little bit of garbage behind. This trash can include pieces of booster rockets and insulation, bolts, paint chips, and even bags of tools.

Some of this debris is tiny, while other pieces are bigger. Scientists at places like the National Aeronautics and Space Administration (NASA) say they are tracking at least 23,000 objects in orbit. (Tracking means that the scientists can see and follow the objects using telescopes.)

When the two satellites collided back in 2009, about 1,000 pieces of debris larger than 4 inches were added to the clutter in a low orbit around Earth.

Spacecraft continue to orbit the earth, and scientists say debris poses a growing threat. The dangers will increase as more satellites are launched into space.

Right now, scientists say they are keeping an eye on how much trash is floating above Earth, and trying to figure out what to do about it. The satellite crash made them take a closer look at how to clean up Earth's cluttered outer reaches.

Discussion Questions:

1. What is space debris?
2. Why are scientists concerned about it?
3. What are some important things that spacecraft do?
4. Why are scientists concerned about space debris?
5. What ideas do you have to clean up the space junk circling Earth?