

Educating Space Age Environmentalists: A Kindergarten-High School Standards-Based Curricular Approach

(Aligned to the Next Generation Science Standards for Earth and Space Science)

GRADE 3



Robert S. Bachelder and Beverly B. Bachelder

www.protectouterspace.com

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Grade 3

Introduction:

Outer space is a valuable natural resource, serving as home to such spacecraft as the GOES-R weather satellite – America’s most advanced weather “eye in the sky”! However, space debris poses a threat to our ability to obtain this crucial data, and solutions must be found.

Through participating in a lesson about climate graphs, aligned with **3-ESS2-1** (Earth’s Systems), students learn how to analyze NASA wind speed climate data using a line plot graph, and to understand the relationship between measurement, data collection, and graphing. A book entitled, *Brady Makes a Weather Graph*, provides an excellent accompaniment to this lesson. It aligns well with the Gr. 3 Common Core ELA standards for reading informational text, as it helps students learn how to use information gained from illustrations to demonstrate understanding of the text.

Extension 1 materials emphasize the key role of satellites in promoting life, health, and safety on Earth. A video, a booklet, a teacher resource page, an article, three recommended websites, and a classroom poster provide students with additional information, games, and activities, as well as an explanation of how satellites provide key weather and climate data that is essential for accurate weather forecasting. A *Storytime from Space* book selection is also recommended to show students how spacecraft play an integral role in space exploration, and in improving life and health on Earth.

Extension 2 features a space debris graphic, a National Public Radio podcast about space debris in which students learn about the Kessler Syndrome and the potential of biomimicry to develop space debris solutions, a NASA “Crazy Engineering” video about the “Gecko Gripper,” and an article. Students write informative/explanatory texts, in alignment with the Grade 3 reading, writing, and speaking and listening standards as outlined in the *Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects*. They share and discuss their work with their classmates, and - as a culminating activity - students design and share their own space junk cleanup robot.

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| Next Generation Science Standards Alignment | Spacecraft Featured: <i>GOES-R Weather Satellite</i> | NASA Main Page for Featured Spacecraft: Click here for GOES-R. |
| <p>Disciplinary Core Idea/Sub-Idea: ESS2. Earth's Systems Weather and Climate (ESS2.D)</p> <p>Grade 3: Earth and Space Sciences</p> <p>ESS2. Earth's Systems</p> <p>3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.</p> |  <p style="text-align: center;">Credit: NASA</p> | <p><i>"And liftoff of NOAA's GOES-R, America's most advanced weather eye in the sky, elevating environmental intelligence to new heights and saving lives!"</i></p> <p style="text-align: right;"><i>-Michael Curie NASA's Launch Commentator</i></p> |

NSTA-Vetted Lesson Plans – NGSS@NSTA

Lesson: "My NASA Data Lesson: Climate Graphs" (NSTA-vetted lesson)

Lesson Overview: The purpose of this lesson is to teach students how to analyze NASA wind speed climate data using a line plot graph, and to understand the relationship between measurement, data collection, and graphing. Students learn how to:

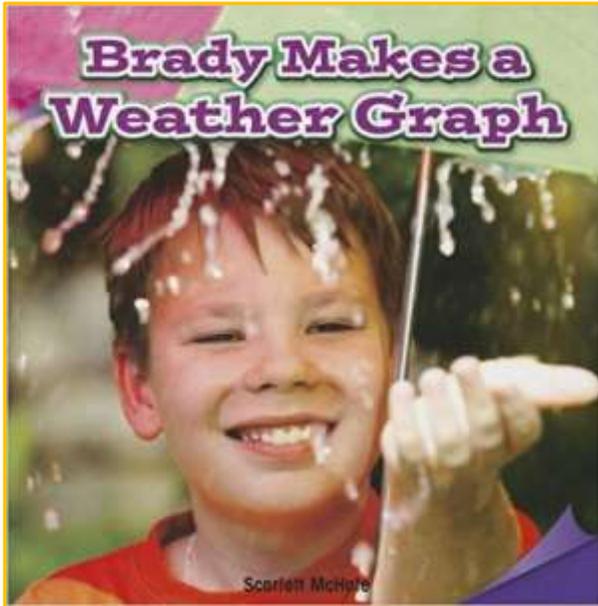
- observe line plot data on Monthly Wind Speed
- identify title and axis labels
- identify highest and lowest value on provided line plot
- evaluate changes in the ocean wind speed over a 10-year average time frame
- draw conclusions about windy vs. less windy months of the year for a certain location
- manipulate data sets from the *MyNASAData* website via printed copy

[Click here](#) for a description of the resource, a full listing of alignment to NGSS, and suggested modifications to more fully align with the NGSS.

[Click here](#) for the lesson.

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: The Geostationary Operational Environmental Satellite-R Series (GOES-R) provides data about clouds and weather patterns that are essential to weather forecasting and studying climate change.



An excellent story book to accompany the lesson is:

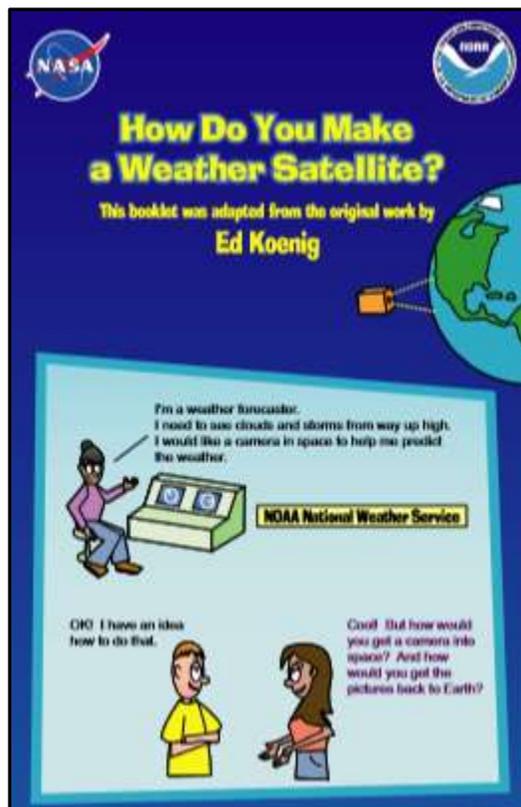
- **Book: McHale, Scarlett. *Brady Makes a Weather Graph*.** New York: The Rosen Publishing Group, Inc., 2014. Print. ISBN: 978-1-4777-2460-6. (Age Range: 8-9 years/Grade Level: 3-4.)

This book is aligned with the *Common Core State Standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects (Reading: Informational Text – CCSS.ELA – Literacy.RI.3.7 – Use information gained from illustrations (e.g., maps, photographs) in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).*

Extension 1 resources include a video, a booklet, a resource page for teachers on weather satellites, an article, three recommended websites, and a classroom poster. A *Storytime from Space* book selection is also recommended to show students how spacecraft play an integral role in space exploration, and in improving life and health on Earth.

- **Video: *Making a Weather Forecast with GOES-R – NOAA and NASA - (3 min.)***

Satellites have become indispensable in providing key weather and climate data that is gathered, transmitted, and utilized in weather forecasting. This excellent video from the National Oceanic and Atmospheric Administration (NOAA) and NASA shows how the GOES-R weather satellite provides the data forecasters use in making weather predictions. [Click here](#) for the video.



- **Informational Booklet – “How Do You Make a Weather Satellite?”** - NASA – adapted by Ed Koenig

This booklet helps students learn about what satellites are, and how they work. A list of key vocabulary words is included. [Click here](#) for the booklet.

- **A resource page** for teachers about this booklet is entitled, *“How Do You Make a Weather Satellite?” Guide for the Classroom* – by Ed Koenig.

This guide is a helpful resource for teachers on answering students’ questions about satellites, in correlation with the “How Do You Make a Weather Satellite?” booklet. [Click here](#) for the guide.

- **Article: “NOAA’s GOES-16 Provides Critical Data on Hurricane Maria”** – NOAA website – Sept. 21, 2017.

[Click here](#) for the article.

- **Websites:**

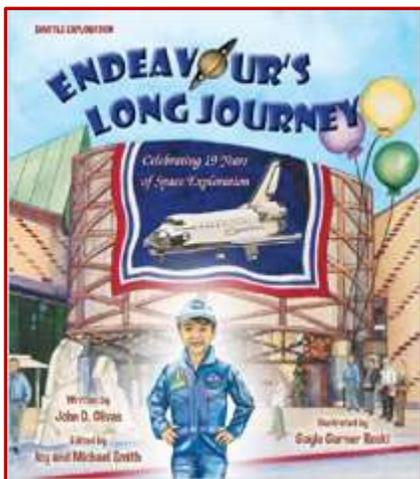
[Click here](#) for more information about the GOES-R satellites.

[Click here](#) for additional videos, activities, and articles about weather and Earth Science.

[Click here](#) for a link to the “Satellite Insight” game from NASA’s Space Place.

- **Poster: GOES-POES** – [Click here](#) for a poster from the SciJinks website.





The classroom poster front illustrates both the Geostationary Operational Environment Satellites (GOES) and the Polar-orbiting Operational Environmental Satellites (POES), and their functions and accomplishments. Back material includes two articles and activities on many of the different parameters meteorologists measure and terms they define in order to describe and predict the weather.

• **Book: Olivas, John D. *Endeavour's Long Journey*.** Manhattan Beach: East West Discovery Press, 2013. Print: ISBN: 978-0985623722. (Recommended by Children's Book Council for ages 7-10.) Written by an astronaut, John Olivas, this book is an official "Story Time from Space" book, bringing the history of the space shuttle Endeavour to life through a young boy named Jojo. Jojo learns about the shuttle's contribution to space science, as well as its famous service missions. The book features NASA photos, fun facts, famous firsts, and quizzes to inspire a love of STEM.

[Click here](#) to see and hear the story being read aloud from the International Space Station (about 15 min.) by Astronaut Tim Kopra, Commander of Expedition 47 on board the International Space Station via the following link:

[Click here](#) for a quick (4 min.) video that gives a little more background on *Story Time from Space*.

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 informative/explanatory piece describing how engineers use biomimicry to design space debris removal technologies with the aid of supporting materials from NPR and NASA and in alignment with the 2017 ELA standards.

Standards Alignment

Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects

Grade 3 Reading Standards for Informational Text [RI]

Key Ideas and Details

CCSS.ELA – Literacy.RI.3.1

1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.

CCSS.ELA – Literacy.RI.3.2

2. Determine the main idea of a text; recount the key details and explain how they support the main idea.

Craft and Structure

CCSS.ELA – Literacy.RI.3.4

4. Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a *grade 3 topic or subject area*.

Grade 3 Writing Standards [W]

Text Types and Purposes

CCSS.ELA – Literacy. W.3.2

2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

CCSS.ELA – Literacy.W.3.2A

- a. Introduce a topic and group related information together; include illustrations when useful to aiding comprehension.

CCSS.ELA – Literacy.W.3.2B

- b. Develop the topic with facts, definitions, and details.

CCSS.ELA – Literacy.W.3.2C

- c. Use linking words and phrases (e.g., *also, another, and, more, but*) to connect ideas within categories of information.

CCSS.ELA – Literacy.W.3.2D

- d. Provide a concluding statement or section.

Production and Distribution of Writing

CCSS.ELA – Literacy.W.3.4

4. Produce writing in which the development and organization are appropriate to task, purpose, and audience.

CCSS.ELA – Literacy.W.3.5

5. Develop and strengthen writing as needed by planning, revising, and editing.

Grade 3 Speaking and Listening Standards [SL]

Comprehension and Collaboration

CCSS.ELA – Literacy.SL.3.1

1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 3 topics and texts*, building on others' ideas and expressing their own clearly.

CCSS.ELA – Literacy.SL.3.1.A

- a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.

CCSS.ELA – Literacy.SL.3.1.B

- b. Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).

CCSS.ELA – Literacy.SL.3.1.C

- c. Ask questions to check understanding of information presented, stay on topic, and link their comments to the remarks of others.

CCSS.ELA – Literacy.SL.3.1.D

- d. Explain their own ideas and understanding in light of the discussion.



Extension 2 resources feature a space debris graphic, a podcast, a video, an article, and a writing activity. The culminating activity is to design a space junk cleanup robot.

1. NASA Space Debris Graphic

Following a discussion about the key role that GOES-R satellites play in providing essential data for weather forecasting and the study of climate change, 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 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](#).)

The screenshot shows the NPR website interface for a podcast episode. At the top, it says 'NEW ENGLAND PUBLIC RADIO' with navigation links for 'news', 'arts & life', 'music', and 'programs'. The episode title is '< Astronauts, Clean Up Your Outer Space!' with a play button icon and a duration of '22:54'. The date is 'July 31, 2017 / 12:01 AM ET'. There are buttons for '+ Queue', 'Download', and 'Embed'. A 'Transcript' button is highlighted. The transcript text includes: 'UNIDENTIFIED MAN #1: Stay seated. Three, two, one, ignition.', 'UNIDENTIFIED MAN #2: Get ready for an adventure of magnificent proportions.', '(SOUNDBITE OF SONG, "WOW IN THE WORLD")', and 'THE POP UPS: (Singing) I don't know what you've been told, but we're in a golden age - so many discoveries that are jumping off the page. Wow in the world. Wow in the world.' Social media icons for Facebook, Twitter, and YouTube are visible on the left side of the transcript area.

2. National Public Radio podcast, entitled “Astronauts, Clean Up Your Outer Space!” (*Wow in the World* - Episode 19 – original air date: July 31, 2017 – 22 min. Have the students listen to this podcast. *Wow in the World* is a radio program that launched in May 2017. It’s described as “a new podcast for kids ages 5-12 that illuminates the wonders of science, technology, discovery and inventions.” The program is hosted by NPR’s Guy Raz and Sirius XM’s Mindy Thomas, who “take kids and their grown-ups on a journey into the most incredible science and kid-friendly news stories of the week.” This episode focuses on the potential of *biomimicry* to serve as an inspiration for inventing space debris cleanup solutions, using animals and plants as the inspiration for new technology. [Click here](#) for the podcast.



3. Following the podcast, discuss the following questions with the students:

- Describe the Kessler Syndrome. Why does this make the space debris problem worse?
- What is biomimicry? What promise does this field hold for space debris cleanup?



4. Video: “Crazy Engineering: Gecko Gripper” – (4 min.) – Published Aug. 12, 2015 by the NASA Jet Propulsion Laboratory

Tell students they will now learn more about the gecko’s amazing qualities that have inspired a space debris solution. Have them view the video. Quoting from the website: *See how geckos inspired a new NASA technology that makes things stick to each other in space. Potential future applications might be to grab satellites to service them or to salvage space garbage to try to clear it out of the way.* [Click here](#) for the video.

5. Article: “Gecko Grippers Moving on Up” – NASA – Aug. 12, 2015. Assign students to read the article, [found here](#).

(Left and below: from video – *Crazy Engineering: Gecko Gripper*)



6. Culminating Activity – Design a Space Junk Cleanup Robot

As a fun culminating activity, have students work in small groups to answer the following question:

“The technology used on the space junk robot was inspired by the special sticky parts of a gecko’s foot. Think about your favorite animal and what they are really good at. A sense of smell? Running fast? What kind of new technology could be inspired by your animal’s special abilities?”

Have each group share their ideas with the class. If desired, have students work individually or in small groups to draw and color a picture of their space junk cleanup robot. This robot might incorporate characteristics of an animal – or perhaps the students might have another idea! Creativity is highly encouraged! Have students write an informational/explanatory text underneath their picture, describing their robot and its qualities, and how these qualities would be helpful in cleaning up space debris. Finally, have the students share their robots and accompanying informational texts with their classmates.

