Bill Nye is a man on a mission: to grow appreciation and excitement for scientific thinking across the world. The former star of the popular kids show *Bill Nye the Science Guy* is now advocating for the importance of science, research and discovery in public life. With intimate and exclusive access—as well as plenty of wonder and whimsy—this behind-the-scenes portrait of Nye follows him as he takes off his Science Guy lab coat and takes on those who deny climate change, evolution and a science-based world view. Directed by David Alvarado and Jason Sussberg, the film features Bill Nye, Neil deGrasse Tyson, Ann Druyan and many others.

As CEO of the Planetary Society, Bill Nye leads the largest nonprofit organization dedicated to educating about space exploration. In this lesson, students will explore one of the promising innovations of space exploration, solar sail technology. Students will learn how solar sailing works, who is involved, how the technology has been tested and where it is headed in the future.

**OBJECTIVES**

By the end of this lesson, students will be able to:
- Articulate why science matters.
- Explore the theory behind the importance and benefits of using a solar sail for space exploration.
- Think creatively about how to teach a science-related topic.

**GRADE LEVELS:** 6-8 and adaptable for 9-12

**SUBJECT AREAS**

<table>
<thead>
<tr>
<th>Science</th>
<th>STEM</th>
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<tr>
<td>Media Studies</td>
<td>English Language Arts</td>
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**MATERIALS**

- Film clips from *Bill Nye: Science Guy*
- Online access for research
- Arts and crafts materials, including paper, markers, cardboard, tinfoil, string and other recycled building materials that students can collect at home.

**ESTIMATED TIME NEEDED**

One-two 50-minute class periods with homework.

**FILM CLIPS**

Film clips provided in this lesson are from *Bill Nye: Science Guy*. Access the
streaming clips for free on POV’s website by visiting www.pbs.org/pov/educators.

Clip 1: “Bill! Bill! Bill!” (3:29 min.)
The clip begins at 0:00 and ends at 3:29 with Bill shooting a scene with a parasail for his show. It demonstrates Bill Nye's popularity among a generation of young people who saw his public television show, Bill Nye the Science Guy. Bill Nye's mission was to make young people more excited about science and encourage them to pursue science as adults, and he was obviously quite successful.

Clip 2: “The Wind from the Sun” (3:16 min.)
This clip starts at 36:38 with famed physicist Neil deGrasse Tyson introducing the Planetary Society and ends at 39:54 with Ann Druyan talking about her excitement about solar sail travel into the cosmos. The clip includes information about the concept of solar sailing, what it meant to the Planetary Society's founder Carl Sagan and why it's important for space travel.

Clip 3: “The Test—Realizing a 40-Year Dream” (4:41 min.)
This clip starts at 58:38 with Bill walking through a door on the day of a LightSail 2 spacecraft test and ends at 1:03:18 with Ann Druyan describing the devastation of the first solar sail launch.

Clip 4: “Somewhere, Something Incredible Is Waiting to Be Known.” — Carl Sagan (6:18 min.)
This clip begins at 1:27:24 with Bill on the beach at sunset as he contemplates the Planetary Society's second attempt at launching solar sail spacecraft. The film ends at 1:33:42 young science enthusiasts reaffirming Bill Nye's influence on making science exciting and accessible to a generation.

ACTIVITY
Step 1: Get Excited About Science!
Begin class by having students complete these sentence stems and share as a large class.
  • Science is . . .
  • We explore space because . . .

Watch Clip 1 and discuss what they noticed and what they liked. Debrief with these questions:
  • When Bill Nye says he “wants to get young people excited about science,” what do you think he means?
  • What does it mean to our nation to have young people passionate and excited about science?

Have students watch Clip 2. In pairs, have students interview one another with the following questions:
  • Why does space exploration matter?
  • What is the most important question you imagine a solar sail spacecraft could
answer?

- Why do you think Bill Nye and the Planetary Society are so excited about light sail technology?

Have student pairs share out for a few minutes in the large group.

**Step 2: What is Solar Sail Technology? What Do We Know About It?**

Have students watch Clip 3, then split the class into small groups no larger than four to read the assigned blog post (below) from the Planetary Society’s website about its light sail program.

Assign each group one of the following questions:


After reading and discussing the post and question, have each group prepare to teach the rest of the class creatively about its assigned topic in a way that is as exciting and engaging as Bill Nye’s show. Suggest using arts and crafts and/or other found building materials for a hands-on experience. Students will have the opportunity to continue their research and plan their lesson in groups as homework.

**Step 3: What Can We Expect to Discover?**

Watch Clip 4 as a group, paying special attention to this quote from Bill Nye:
“The reason we have these rockets on the horizon is to know our place in the cosmos. ... 39 years after Carl Sagan showed this thing on The Tonight Show we’re going to launch a solar sail as part of his legacy. It gives me great pause. It’s my responsibility.”
- Bill Nye

Discuss the following questions together:

- Why is it important to “know our place in the cosmos”?
- Why do you think Bill Nye feels launching the light sail is a responsibility?
- Who benefits from scientific exploration, and in what way?
- What do you think is the best way to get young people excited about science?

**HOMEWORK**

Students should finish preparing their demonstrations together in groups outside of class, and present to one another for no more than 10 minutes.

For middle school: Ask students to teach the lesson they create to the rest of the class.

For high school: After providing the lesson they planned, ask high school students to explain why they designed their lesson the way they did, both spelling out what information they wanted to teach, and in what ways they hoped their lesson would be engaging. An alternative “Pitch Slam” for high schools described in the Extension section.

**EXTENSIONS**

**For High School: Solar Sail Pitch Slam (aka Shark Tank)**

In groups, have students generate a question they believe a solar sail mission might explore and design “pitches” to potential investors to convince them to invest in an expedition into space. Each pitch should include the following information:

- What will your mission do?
- How will your mission contribute to the field of solar sailing?
- What will happen if you fail?
- What is the “return” to investors (not just money, can include ideas and knowledge)?

Consider the February 7 SpaceX launch of the Falcon Heavy rocket and this New York Times article as background material:

Hold a pitch slam in class. Each team gets two minutes to “pitch” their idea. Have a panel of “judges” pick the winning pitch.

**Citizen Science**
The Planetary Society is citizen-funded, meaning people rather than the government pay for its efforts. Read this article about various citizen science efforts around the world: https://endpoints.elysiumhealth.com/citizen-science-253260d1416e

Ask students to choose one of the projects listed that interest them and describe the project to the rest of the class by arguing how the goal of the study will benefit people.

RESOURCES
This is a list of organizations, websites, articles and other materials that may be helpful to teachers in developing the lesson, or for students as they are researching.

POV: Bill Nye: Science Guy
http://www.pbs.org/pov/billnyescienceguy/
The film's official POV site includes a discussion guide with additional activity ideas, steps to borrow the DVD from the POV Lending Library and other resources.

Film Official Website
https://www.billnyefilm.com/
The film's official website provides information on the film and filmmakers, as well as screenings and press information.

POV: Media Literacy Questions for Analyzing POV Films
http://www.pbs.org/pov/educators/media-literacy.php
This list of questions provides a useful starting point for leading rich discussions that challenge students to think critically about documentaries.

Hands-on Activity: Solar Sails: The Future of Space Travel
https://www.teachengineering.org/activities/view/cub_space8_lesson01_activity2
Lesson from Teach Engineering, in which students design and build a model solar sails.

National Geographic: New NASA Spacecraft Will Be Propelled By Light
https://news.nationalgeographic.com/2016/02/160202-solar-sail-space-nasa-exploration/
National Geographic article from February 2016 on solar sail technology.

NASA Facts: Solar Sail Propulsion
https://www.nasa.gov/pdf/134645main_solar_sail_fs.pdf
National Aeronautics and Space Administration fact sheet on solar sail propulsion.

Solar Sails: The Next Generation of Space Propulsion
The physics behind solar sails, explained.

NASA Science: A Brief History of Solar Sails
A narrative history of solar sailing.

**STANDARDS**
Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

Content Core Standards for English Language Arts Standards » Science & Technical Subjects » Grade 6-8 » 1

**CCSS.ELA-LITERACY.RST.6-8.1**
Cite specific textual evidence to support analysis of science and technical texts.

**CCSS.ELA-LITERACY.RST.6-8.2**
Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

**CCSS.ELA-LITERACY.RST.6-8.7**
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

NextGen Cross-Cutting Standards, MS-PS2 Motion and Stability: Forces and Interactions

- Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1) (MS-PS2-4)
- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)

**ABOUT THE AUTHOR**
Blueshift is a team of education specialists with background in environmental and social impact work. The team recognizes and builds on the power of documentary film in reaching broad audiences to spark energy for deep and lasting social change. The team works with filmmakers, photographers and writers to develop innovative educational strategies, experiences, tools and resources that bring stories off the screen and into viewers’ lives.