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Educator Resource Guide
for
SPACEMAN
by Mike Massimino

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Guide Includes:

- Both ELA and STEM classroom activities with corresponding Common Core State Standards;

- A timeline tracing the history of the telescope from its invention to the creation of the Hubble Space Telescope, which Mike Massimino worked with on his missions;

- Recommendations for further books, films, music, and websites that will enrich any *Spaceman*-related lesson plan;

- And questions to guide faculty reading.

ELA Activities for Spaceman by Mike Massimino

(Common Core Standards listed at the bottom)

	Location in the book	
1.	Prologue	Mike Massimino writes about the first time he launched from Earth. Write 1,000 words about a time you did something that made you scared. Why did you do this thing? How did you feel before you began? How long did the event feel like it lasted? How long was it actually? How did you feel after the activity? Would you do it again? Why or why not?
2.	Part 1	On page 6, Massimino says about watching the first moon landing, "To a six-year-old in the suburbs on Long Island, it was the most awe-inspiring thing in the world. Something about it grabbed me down deep in my soul." As a class, discuss events in the students' lives that have been awe-inspiring.
3.	Part 1	On page 7, Massimino says, "Even at that age I remember thinking, *This is the most important thing that's happening right now – and not just now, ever. This is going to mark our time on the planet: the fact that we were the first people to leave it.*" As a class, discuss some events are that have changed/will change our world. The events may be past, present, or future. Explain your answers.
4.	Part 1	In *Most All-Around*, Massimino talks about failing a couple of tests as a junior and using that failure as a wake-up call. As a class, discuss how failure is sometimes more important that success. What motivations have driven the students to succeed at something that they originally did not do well in?
5.	Part 1	What do you want to do with your life? Research the paths you need to follow to get there. Write out three different scenarios that will get you to your ultimate goal. OR if you do not have a definite goal, research three possible ways you may want to spend your life. Write one scenario for each possible goal, showing how you might get there.
6.	Part 2	On page 36, Massimino says, "You can learn a lot by getting knocked down." As a class, discuss whether or not this is true.
7.	Part 2	On page 55, Massimino says, "I think the self-made man is a myth". As a class, discuss how teamwork has helped you accomplish something you could not have accomplished alone.
8.	Part 2	On page 49, Massimino says, "The chances of my doing that [passing the qualifying exams for his Ph.D] successfully were pretty much zero, but if I didn't at least try, I'd always look back and be disappointed with myself." When have you thought this? Describe the situation and tell what you did or did not do.
9.	Part 2	On page 52, Massimino talks, for the first time, about the "deal-breaker": his poor eyesight. Throughout the book, he mentions how this physical limitation could keep him from achieving his dream. Regardless, he pursues his goal, knowing that he might never make it. What is something that you are willing to strive for, regardless of the outcome?
10.	Part 3	Every astronaut gets a nickname. If you could pick a nickname for yourself, what would it be? Why?

11. Part 3 — At the beginning of Chapter 12, *Shackleton Mode*, Massimino says that in the history of human exploration, there are basically two types of people: scientists and adventurers. If you had to describe yourself as one of these, which would it be? Explain your answer.

12. Part 3 — Think about a time when you were in the middle of a bad situation and then you suddenly realized that there was something wonderful in, near, or around you. Describe that time.

13. Part 4 — Write a 1,000-word essay. Part of your essay should be a biography of Edwin P. Hubble and the other part is to give your opinion as to whether or not the Hubble Telescope should have been named for him, or, if you don't agree with the decision, tell for whom you would have named the telescope and explain your reasoning.

14. Part 4 — Chapter 16, *Earth is a Planet*, reveals some of the music the ground crew played to wake up the astronauts. If you were to pick a wake-up song for the astronauts, what would it be? Explain your answer.

15. Part 4 — Look at one of the pictures taken by the Hubble Telescope. What does it make you think of? Think not in terms of science, but about the art of the picture. Write 250 words about the picture. Then find out what it actually a picture of. Write 250 words comparing the reality to your imagination.

16. Part 4 — Look at a different picture taken by the Hubble Telescope. Again, think about it as art rather than science. What music could you put with the picture? *Note:* Teachers, you may want to show the first section of Walt Disney's Fantasia, *Toccata and Fugue in D Minor* by Johann Sebastian Bach, before doing this activity. It shows abstract designs put to music.

17. Part 5 — When talking about going to the Moon for the first time, President Kennedy said, "We set sail on this new sea because there is new knowledge to be gained, and new rights to be won, and they must be won and used for the progress of all people." As a class, discuss what he meant by this and whether or not you agree.

18. Part 5 — On page 248, Massimino says, "Exploration is what we do. It's a basic human need, the drive to know more merely for the sake of knowing it." Discuss this as a class.

19. Part 5 — Imagine someone asks you for your autograph. What would you have done in order to have fans? Write 500 words explaining your answer.

20. Part 5 — Who is one of your heroes? Why? Write 500 words explaining your answer.

21. Part 6 — Massimino illustrates many lessons that can be applied to everyday life. Write a 1,000 word essay about one of them and how you have or will use it in your own life.

Common Core Standards for ELA Activities

Standard	ELA Activity Number
CCSS.ELA-LITERACY.L.9-10.1	1, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.L.11-12.1	1, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.L.9-10.2	1, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.L.11-12.2	1, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.L.9-10.3	1, 8, 9, 10, 11, 12, 13, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.L.11-12.3	1, 8, 9, 10, 11, 12, 13, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.RI.9-10.1	13
CCSS.ELA-LITERACY.RI.11-12.1	13
CCSS.ELA-LITERACY.RI.9-10.2	21
CCSS.ELA-LITERACY.RI.11-12.2	21
CCSS.ELA-LITERACY.RI.9-10.10	13, 21
CCSS.ELA-LITERACY.RI.11-12.10	13, 21
CCSS.ELA-LITERACY.RL.9-10.2	21
CCSS.ELA-LITERACY.RL.11-12.2	21
CCSS.ELA-LITERACY.RL.9-10.10	21
CCSS.ELA-LITERACY.RL.11-12.10	21
CCSS.ELA-LITERACY.SL.9-10.1	2, 3, 4, 6, 7, 17, 18
CCSS.ELA-LITERACY.SL.11-12.1	2, 3, 4, 6, 7, 17, 18
CCSS.ELA-LITERACY.SL.9-10.3	3
CCSS.ELA-LITERACY.SL.11-12.3	3
CCSS.ELA-LITERACY.W.9-10.1	13
CCSS.ELA-LITERACY.W.11-12.1	13
CCSS.ELA-LITERACY.W.9-10.2	5
CCSS.ELA-LITERACY.W.11-12.2	5
CCSS.ELA-LITERACY.W.9-10.3	1, 8, 9, 12, 19
CCSS.ELA-LITERACY.W.11-12.3	1, 8, 9, 12, 19
CCSS.ELA-LITERACY.W.9-10.4	1, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.W.11-12.4	1, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.W.9-10.5	1, 5, 8, 10, 11, 12, 13, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.W.11-12.5	1, 5, 8, 10, 11, 12, 13, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.W.9-10.7	5, 13
CCSS.ELA-LITERACY.W.11-12.7	5, 13
CCSS.ELA-LITERACY.W.9-10.8	13
CCSS.ELA-LITERACY.W.11-12.8	13
CCSS.ELA-LITERACY.W.9-10.9	13
CCSS.ELA-LITERACY.W.11-12.9	13
CCSS.ELA-LITERACY.W.9-10.10	1, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21
CCSS.ELA-LITERACY.W.11-12.10	1, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21

STEM Activities for Spaceman by Mike Massimino

(Common Core Connections or Next Generation Standards listed at the bottom)

	Location in the book	**Answers are bolded. Many answers are not given as the answers will vary.**
1.	Part 3	When training to be an astronaut, you have to go weightless. - Why do we feel weight on Earth? - If you weigh 100 pounds on Earth, how much would you weigh in zero gravity? **0** How much would you weigh on Mars? **38** On Venus? **91** On Jupiter? **236**
2.	Part 3	How fast do you need to go to break the sound barrier at sea level, 20° Celsius or 68° Fahrenheit? **At least 761 mph.**
3.	Part 3	Currently, it is impossible to go faster than light. Research why that is. Do you think we will someday be able to go faster than light? Explain your answer.
4.	Part 3	Give a two- to five-sentence description of each of the Mercury missions.
5.	Part 3	Give a two- to five-sentence description of each of the Apollo missions.
6.	Part 3	When Massimino went to Cold Lake, he and the other people on the trip put foil under their sleeping bags. Why? **Foil is used to reflect and retain heat and to keep moisture out of the sleeping bags.**
7.	Part 4	The Hubble Telescope was placed into Earth orbit by the shuttle *Discovery* in April 1990. Why? Give three reasons why astronomers want a space telescope to begin with. **- Exposure times are not limited to day/night cycle.** **- Telescope can "see" in other wavelengths of light.** **- Weather is not a factor.** **Please note that "because it's closer" and similar answers are wrong, due to the vast distances involved. In fact, the HST might be *further away* from an object it's observing than a ground-based telescope would be.**
8.	Part 4	After reading the first paragraph in Chapter 13, *Seeing Beyond the Stars*, describe how you feel about the Hubble Space Telescope.
9.	Part 4	The Hubble Telescope mirror is made from quartz from North Carolina. Why was the quartz from that state? **Quartz from the Spruce Pine mining district in NC is some of the purest Silicon Dioxide in the world.**
10.	Part 4	How many servicing missions have been made to the Hubble Telescope? **Five** Write a two- to five-sentence summary of each mission.
11.	Part 4	The Hubble orbits Earth every ninety-seven minutes. Starting at your school, how far could you drive in ninety-seven minutes? How far could you walk? Explain your answers.
12.	Part 4	Besides city lights, name five things on Earth that are visible from space **Answers will vary,**

but may include bodies of water, large cities, mountain ranges, ice caps, weather systems.

13. Part 4 The Advanced Camera for Surveys cost $76 million; the budgeted cost of the mission to install the camera was $172 million. Nationally, states spend about $11,009 per student in education. Find out what your state's education budget is. It may be easiest to find the number of students and multiply that by $11,009. After looking at pictures that the Hubble has sent back, decide if it is worth the cost. Show the figures you are using and explain your answer.

14. Part 4 At the end of chapter 16, *Earth is a Planet*, Massimino talks about how he sees the Earth with its streets and buildings as spinning while the sun stays still, as opposed to most of us who see the sun moving and the Earth staying still. Does this change in perspective matter? Explain your answer.

15. Part 4 Massimino's Hubble mission covered 3,941,705 miles. If they had taken a piece of string that was that same length and wrapped it around Earth, how many times would the string have gone around our planet? Round to the nearest whole number.

16. Part 4 The Overview Effect (see below)

17. Part 5 How many astronauts have been outside low Earth orbit? **27**
How many have been killed in a mission? **17 (Note that this is astronauts ONLY, and that no astronauts died outside of LEO).**

18. Part 5 What does Massimino claim is the most valuable piece of equipment you can have in space? Do you agree? Explain your answer. **See page 250 – human beings.**

19. Part 6 You get more torque (a twisting force that tends to cause rotation) by applying force to a longer lever than you get applying the same amount of force to a shorter lever. Who is attributed with the saying, "*Give me a lever* long enough and a fulcrum on which to place it, and I shall *move the world*"? **Archimedes**

20. Part 6 Working in Space: Take Me to Your Motherboard (see below)

The Overview Effect: Changing Perspectives on the Earth

Part One: What do you think of when someone says "Earth" to you? Write down two or three phrases you'd use to describe Earth to a friend. **Answers will vary.**

Part Two: History: Yuri Gagarin, the first human in space in 1961, said, "I saw for the first time the Earth's shape. I could easily see the shores of continents, islands, great rivers, folds of the terrain, large bodies of water. The horizon is dark blue, smoothly turning to black. . . the feelings which filled me I can express with one word—joy." Gagarin was describing what he saw through his spacecraft's window. This was the first observation of the Overview Effect, but certainly not the last. "The Earth was absolutely round . . . I never knew what the word round meant until I saw Earth from space," said fellow cosmonaut Alexei Leonov. Leonov would be the first human to do a spacewalk in 1965.

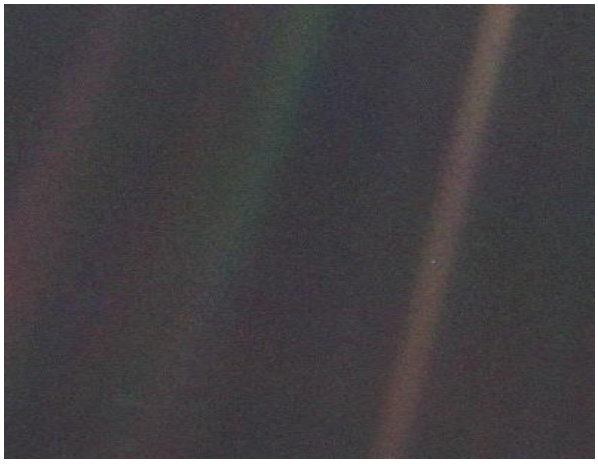
America's first moonwalker, Neil Armstrong, had this to say about seeing the Earth from the surface of the moon: "It suddenly struck me that that tiny pea, pretty and blue, was the Earth. I put up my thumb and shut one eye, and my thumb blotted out the planet Earth. I didn't feel like a giant. I felt very, very small."

Many astronauts have similar experiences upon seeing the earth as a discrete object outside their perspective in space, including Mike Massimino. As Massimino describes it, "…We're out here, spinning in all this chaos. The Earth is a planet. The Earth is a *spaceship*, and we're all space travelers."

Here is a picture of Earth rising over the moon. How would you describe the Earth in this image? **Answers will vary.**

http://www.nasa.gov/multimedia/imagegallery/image_feature_1249.html

Part Three: Carl Sagan asked NASA to take a picture of the earth from beyond Neptune, using Voyager 2's camera. Here is that picture. Can you find Earth in the image below? **About halfway down, on the right hand side, inside the bright stripe-that small dot.**



How does this image make you feel? **Answers will vary, but will probably include words such as small, insignificant, etc.**

Part Four: Sagan wrote a great deal about this image, including the following excerpt from Pale Blue Dot: A Vision of the Human Future in Space, 1994.

"The Earth is the only world known so far to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment the Earth is where we make our stand. It has been said that astronomy is a humbling and character-building

experience. There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known."

Write down two or three phrases you'd use to describe Earth to a friend. Did your phrases change based on these images and descriptions? Why or why not? **Answers will vary.**

Working In Space: Take Me To Your Motherboard

During STS-125, Massimino was charged with the task of removing and replacing the electrical circuit board for the STIS (Space Telescope Imaging Spectrograph). He goes into great detail about the stages of the repair and what it would take to do it on pages 284-294. We can't approximate all of the challenges he faced, but we can get an idea of the intricacies involved, by using household items, a time limit, and a NON-WORKING computer. Note: Be sure the computer has been out of service long enough to drain the capacitors so that there is no risk of electrical shock.

Materials Needed:

Phillips head screwdriver; outdoor or gardening gloves; old non-working desktop computer (with keyboard, mouse, monitor, and power cord); small enclosed space (underneath a desk, for example); all artificial light off, but window shades may be opened; timer set to 20 minutes.

Procedure: Before you begin, set the timer to 20 minutes.

1. Put on the gloves.
2. Remove and unfasten all external components of the computer. Place the computer under or into the enclosing space. The enclosing space must be less than 36 inches in all three dimension.
3. Remove the set screws in the back of the computer. Remember, you'll need all of these in order to properly reassemble the computer later!
4. Remove the chassis of computer, and carefully remove any dust or foreign objects you find without dropping them into the computer's body.
5. Locate the motherboard in the body of the computer.
6. Remove the screws holding the motherboard in place.
7. Carefully remove the motherboard, making sure not to damage or bend any of the set pins.
8. Pass the motherboard off to your teacher for inspection (this mimics replacing the old one for the new one).
9. Carefully re-seat the motherboard into the computer.
10. Screw the motherboard back into place.
11. Re-seat the chassis of the computer, and reinstall all of the screws.
12. Extricate yourself from the enclosed space.
13. Place the computer on the desktop, and rewire all components as if you were going to restart it (power cord, keyboard, mouse, and monitor).
13. Remove the gloves.
14. Check the timer. Did you accomplish the task within 20 minutes?

Conclusions:

1. Did you properly complete the task in less than 20 minutes?
2. List the difficulties you encountered along the way.
3. Massimino talks about what happened when things unexpectedly went wrong during his repair procedure. What went wrong, and why was it so potentially bad?

In the Hubble repair mission, one of the large screws for the handrail became stripped, which no one had anticipated or trained for this problem. If he could not get the handrail off, the mission would have to be aborted.

4. Could a robot have done what you did? Then, after thinking about and explaining your answer, decide if a robot could have accomplished what Massimino did in repairing the STIS. Explain your answer.
5. Worst case scenario during this activity: you busted an already broken computer.

What were the potential consequences of failure for Massimino and the Hubble Telescope?

a) Foreign objects getting into the interior of the telescope (FOD)

b) The STIS remains nonworking

c) Metal debris could have ripped the spacesuit, resulting in death.

Common Core or Next Generation Standards for STEM Activities

Standard Number	STEM Activity Number
CCSS.ELA-LITERACY.L.9-10.1	3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 16, 18, 20
CCSS.ELA-LITERACY.L.11-12.1	3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 16, 18, 20
CCSS.ELA-LITERACY.L.9-10.2	3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 16, 18, 20
CCSS.ELA-LITERACY.L.11-12.2	3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 16, 18, 20
CCSS.ELA-LITERACY.L.9-10.3	3, 8, 13, 14, 16, 18, 20
CCSS.ELA-LITERACY.L.11-12.3	3, 8, 13, 14, 16, 18, 20
CCSS.ELA-LITERACY.RI.9-10.1	14, 18, 20
CCSS.ELA-LITERACY.RI.11-12.1	14, 18, 20
CCSS.ELA-LITERACY.RI.9-10.2	18, 20
CCSS.ELA-LITERACY.RI.9-10.10	14, 18, 20
CCSS.ELA-LITERACY.RI.11-12.10	14, 18, 20
CCSS.ELA-LITERACY.RL.9-10.1	14, 18
CCSS.ELA-LITERACY.RL.11-12.1	14, 18
CCSS.ELA-LITERACY.RL.9-10.2	18
CCSS.ELA-LITERACY.RL.9-10.10	14, 18
CCSS.ELA-LITERACY.RL.11-12.10	14. 18
CCSS.ELA-LITERACY.RST.9-10.1	3, 6, 7, 8, 16, 18
CCSS.ELA-LITERACY.RST.11-12.1	3, 6, 7, 8, 16, 18
CCSS.ELA-LITERACY.RST.9-10.2	4, 5, 10
CCSS.ELA-LITERACY.RST.11-12.2	4, 5, 10
CCSS.ELA-LITERACY.RST.9-10.3	20
CCSS.ELA-LITERACY.RST.11-12.3	20
CCSS.ELA-LITERACY.RST.9-10.5	1
CCSS.ELA-LITERACY.RST.9-10.8	3
CCSS.ELA-LITERACY.RST.11-12.8	3
CCSS.ELA-LITERACY.RST.9-10.9	3, 12
CCSS.ELA-LITERACY.RST.11-12.9	3, 12
CCSS.ELA-LITERACY.RST.9-10.10	1, 2, 3, 4, 5, 6, 7, 9, 10, 12, 13, 14,
CCSS.ELA-LITERACY.RST.11-12.10	1, 2, 3, 4, 5, 6, 7, 9, 10, 12, 13, 14,
CCSS.ELA-LITERACY.W.9-10.1	3, 13, 14, 18, 20
CCSS.ELA-LITERACY.W.11-12.1	3, 13, 14, 18, 20
CCSS.ELA-LITERACY.W.9-10.2	6
CCSS.ELA-LITERACY.W.11-12.2	6
CCSS.ELA-LITERACY.W.9-10.4	3
CCSS.ELA-LITERACY.W.11-12.4	3
CCSS.ELA-LITERACY.W.9-10.7	1, 2, 3, 7, 9, 12, 13, 17, 19
CCSS.ELA-LITERACY.W.11-12.7	1, 2, 3, 7, 9, 12, 13, 17, 19
CCSS.ELA-LITERACY.W.9-10.9	3, 8, 13
CCSS.ELA-LITERACY.W.11-12.9	3, 8, 13

CCSS.ELA-LITERACY.W.9-10.10	3, 4, 5, 8, 10, 13, 14, 16, 18
CCSS.ELA-LITERACY.W.11-12.10	3, 4, 5, 8, 10, 13, 14, 16, 18
CCSS.MATH.CONTENT.HSA.CED.A.1	11, 15
CCSS.MATH.CONTENT.HSA.CED.A.2	11
CCSS.MATH.CONTENT.HSA.REI.A.2	11
CCSS.MATH.CONTENT.HSA.REI.B.3	13
CCSS.MATH.CONTENT.HSN.Q.A.3	13
CCSS.MATH.PRACTICE.*MP2*	1, 3, 11, 13, 15
HS-ETS.A	20
HS-ETS.C	20
HSN-Q.A.1	1, 11, 13, 15
HS-PS2.A	19
HS-PS3-4.	6
HS-PS4.A	2
HS-PS4.B	7
HS-PS4.C	3, 7
HS-PS4.D	7

Telescopes in Space Timeline

Do you think that Hubble is the only space-based telescope? Actually, over 50 telescopes have been deployed and used in space since 1970. From the time Egyptians first polished rock crystals 4,500 years ago, people have wanted to look at more than what the naked eye can see. Below is a brief history of telescopes.

You may want to use this information to do some deeper research on your own.

1608	The telescope is invented by Hans Lippershey.
1609	Galileo Galilei builds his own telescope and discovers four of Jupiter's moons, craters on our Moon, and sunspots.
1611	Johannes Kepler first uses a convex lens that helped to reduce spherical irregularities.
1616	Niccolo Zucchi creates a reflecting telescope using a lens and a concave spherical mirror to magnify objects and, in 1630, discovers Jupiter's belts.
1617	Christoph Scheiner adds a third lens to a terrestrial telescope to make the images right side up.
1659	Christian Huygens discovers the true shape of Saturn's rings.
1663	James Gregory creates a reflective telescope, using two mirrors whose reflection creates a conical image. This is known as a Gregorian telescope.
1668	After studying the reflection of light through prisms, Isaac Newton improves the reflecting telescope by using a paraboloid primary mirror and a flat diagonal secondary mirror.
1670	Johannes Hevelius builds a 150-foot-long refracting telescope.
1672	Laurent Cassegrain develops a telescope that used a parabolic primary mirror and a hyperbolic secondary mirror. That design is still used today.
1721	John Hadley improves Newton's telescope by using a Gregorian design.
1733	Chester Moore Hall makes a lens made by cementing two different types of glass – crown and flint – together in order to reduce chromatic distortions.
1789	William Herschel builds a telescope that is over 39 feet. It is the first huge reflector telescope. In 1781, he discovers Uranus.
1845	William Parsons builds the "Leviathan of Parsonstown". With a six-foot diameter of its primary mirror, it is the largest telescope ever built until the 20th century and Parsons used it to be the first to view a spiral nebulae (arms of a galaxy).
1897	Alvan Clark builds the Yerkes Telescope in Wisconsin. It is the largest refracting telescope yet. Reflecting telescopes use mirrors, while refracting telescopes use glass lenses. As the size of a telescope became important, more and more dependence was given to reflecting telescopes because, with a large enough lens, a telescope could buckle under its own weight. Mirrors weigh less than glass lenses.
1917	The Hooker Telescope is built in Pasadena, CA. With it, Edwin Hubble concludes that the Andromeda Nebula is outside of the Milky Way Galaxy.
1937	Grote Reber builds a radio telescope that essentially could see radio waves, which are invisible to the naked eye.
1957	Bernard Lovell builds a 250-foot radio telescope that could be pointed anywhere in the sky.
1971	Apollo 16 deploys a far UV telescope and images several targets. It is the first telescope deployed by astronauts in space. Ultraviolet images help show the age of planetary objects.
1989	The Hipparcos Satellite carries the Schmidt telescope into space to catalogue the parallax of thousands of nearby stars. A parallax is the apparent shift in position of an object against the background of distant objects. Once the parallax is computed, the star's (or other object's) distance from Earth can be computed trigonometrically.

1990	The Hubble Space Telescope is the first telescope to be launched into space. Because it is above the turbulence of our atmosphere, it gives a much clearer picture of the stars and planets than do telescope here on Earth.
1991	The Compton Gamma Ray Observatory is the first space telescope to look at gamma rays (high-energy waves).
1995	The W. M. Keck Observatory is a two-telescope observatory and is near the summit of Mauna Kea in Hawaii. It is 13,600 high and is the 2nd largest optical telescope in the world.
1995	The Solar and Heliospheric Observatory (SOHO) is focused on our sun in order to better predict the weather. It has also found 1,500 new comets.
1999	The Chandra X-ray Telescope has found several black holes.
1999	The X-ray Multi-Mirror Mission (XMM-Newton) detects X-rays to make long, uninterrupted observations and has found galaxies billions of light years from Earth.
2000	The Gemini Observatory has twin telescopes, each more than 26 feet across, in two different location: Hawaii and Chile. They work in tandem to view the entire sky.
2002	The Integral or International Gamma-Ray Astrophysics Laboratory is used to observe objects in X-rays, gamma rays, and visible light all at the same time. It is also intended to perceive supernova explosions.
2003	The Spitzer Space Telescope uses infrared to study black holes, comets, and exoplanets.
2003	The Galex (Galaxy Evolution Explorer) studies the shape, size, distance, and brightness of galaxies beyond our universe.
2004	The Swift Gamma Ray Burst Explorer looks for gamma-ray bursts, powerful explosions that last for only a few seconds, but that leave an afterglow of visible, X-ray, and ultraviolet light.
2005	The Large Binocular Telescope in AZ is completed. Its exceedingly clear image has allowed it to discover a galaxy cluster over seven billion light years from Earth in 2008.
2006	The Convection Rotation (COROT) has two main goals: to look for extrasolar planets and to perform stellar seismology.
2006	The Solar Terrestrial Relations Observatory (STEREO) is two different spacecraft that stereoscopically takes 3D images of the Sun.
2008	The Fermi Gamma-ray Telescope looks at gamma rays which are used to detect dark matter, black holes, and spinning pulsars.
2009	The Herschel Space Observatory is launched. It uses infrared to look into space; its primary mission is to find water.
2009	The Planck Observatory concentrates on the microwave light of the universe and uses that to map the magnetic field of the Milky Way in 3D.
2009	The Kepler Telescope looks for Earth-like planets.
2010	The Gran Telescopio Canarias, on the island of La Palma in the Canary Islands, is 7,438 above sea level and is the largest telescope to date.
2018	James Webb Space Telescope is the Hubble successor. Like the Hubble, it will search for light from the first stars and galaxies.

Resources:

Books:	*Hubble: Imaging Space and Time*	by David H. Devorkin and Robert Smith
	Universe: Images from the Hubble Telescope	by Leo Marriott
	Hubble: A Journey Through Space and Time	by Edward Weiler

Websites	http://hubblesite.org/the_telescope/team_hubble/servicing_missions.php#sm3b
	http://www.kidsastronomy.com/telescopesD.htm
	http://ngm.nationalgeographic.com/2009/07/telescopes/telescopes-interactive
	http://www.scientus.org/timeline/telescope.html
	http://www.space.com/6716-major-space-telescopes.html
	http://er.jsc.nasa.gov/seh/ricetalk.htm

Related Material:

Films/TV:	*The Right Stuff* Note: before showing this to your students, preview it. Although it is rated PG, there are many scenes that contain inappropriate language/ideas/visuals.
	Top Gun
	Apollo 13
	Gravity
	The Martian
	Armageddon
	The Simpsons: Deep Space Homer
	Hubble 3D
	The Big Bang Theory
	Walt Disney's Fantasia, part 1: *Toccata and Fugue in D Minor* by Johann Sebastian Bach

Music:	*Blue Telescope*	artist: John Hiatt
	theme from *Mission Impossible*	composer: Lalo Schifrin
	Five Variations on *Twinkle, Twinkle Little Star*	
	OK Computer	artist: Radiohead
	Dances with Wolves soundtrack	artist: John Barry
	Meet Joe Black soundtrack	artist: Thomas Newman
	New York State of Mind	artist: Billy Joel
	Space Oddity	artist: Davie Bowie

Questions for Faculty Reading

Part 1:

1. On page 10, Massimino says, "A lot of people, when they meet me, can't believe I've been to space. They say I look like a guy who'd be working at a deli in Brooklyn, handing out cold cuts." Reflect on how people's perceptions of what we look like or where we live affects how those people think of us. Discuss how those same perceptions affect how we think of ourselves. What childhood dreams of yours are equivalent to saying, "I want to grow up to be Spider-Man"? What preconceived perceptions do you have of your student body as a whole? Of particular families? Of a certain student?

2. In *Who You Gonna Get?*, Massimino talks about applying to the wrong college. What events in your life have seemed wrong at the time, but turned out to be a good thing? Reflect on the saying "Life is a journey, not a destination." Do you agree or disagree with that statement?

Part 2:

3. On page 39, Massimino sees Michael Collins, an Apollo 11 astronaut, and wants to talk to him. Massimino says, "I was beyond intimidated, but I knew if I didn't approach him, I would regret it for the rest of my life." Think about a time you were scared to do what you knew was the right thing. Did you do it? Why or why not? How did you feel later? Do you think you made the right decision? Why or why not? How do you think your life would have changed if you had made a different decision?

4. On page 50, Massimino says, "I looked out over the cliffs and I thought about the explorers who had sailed from this point, what they'd accomplished, mapping the known world, charting our place in the universe. How many times had they failed and fallen down only to get back up and try again? How many times had they sailed out on an impossible voyage and made a successful return home?" Think about times in history when people did the impossible and when they had failed and given up. How have those times impacted our lives today?

5. On page 55, Massimino says, "I think the self-made man is a myth," explaining that teamwork accomplishes more than individual achievements. As teachers, we often work alone. Do you believe that teamwork is important in teaching or can you get more done by yourself? Explain your answer.

Part 3:

6. Think about a nickname you have given a student, even if you never shared that nickname with anyone, including the student. Why did you pick that name for the student? How did it cement your feelings about the student?

7. At the very end of Part 3, Massimino explains that, "Going to space doesn't make you an astronaut. Being an astronaut means you're ready to go to space." How are those two statements different? Does it matter which way being an astronaut is defined? Fill in the blank: _____ makes you a teacher. Explain your answer.

Part 4:

8. Massimino was chosen to join the crew because "no matter how stressful the situation, [he] could keep it light and fun." What is one quality that would get you chosen as part of a team? Explain your answer.

9. Take a dollar bill and a pair of scissors. Nip off one of the corners of the bill, as small as you can cut it. That is the percentage of your tax dollar that goes to NASA, which is 0.004 (0.4%) of a dollar Based on the results sent back of just the Hubble Telescope alone, is this a worthwhile investment? Explain your answer.

Part 5:

10. Reflect on President Kennedy's famous quote, "We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills." Do you use this idea in teaching? Why or why not?

11. Is it important to have heroes in your life? Explain your answer.

Part 6:

12. In chapter 21, *From the Ashes*, Massimino talks about the odds of taking a hit from the external fuel tank's foam insulation. He says that the probability of a catastrophic hit for two shuttles, mathematically speaking, was not zero, but was pretty low. Imagine you are on the crew of one of those shuttles. What would you consider an acceptable risk? How does that fit into your notion of exploration and its value?

13. Pick one of the life lessons Massimino illustrates in his book. How do you pass on this lesson to your students? Give specific examples.

14. Massimino shares one of NASA's sayings, "There is no problem you can't make worse." Describe a time in your classroom when this was the case. What did you do? Was there a positive outcome? Explain your answer.