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## Flying into Outer Space on Reusable Rockets

On September 12, 1962, President John F. Kennedy gave a speech at Rice University which launched the race to the moon. His speech was inspirational and the human efforts to accomplish the task he set are now all history. If you are too young to remember the actual moment, a short

place as air travel, rocket ships need to become as reusable as airplanes.

SpaceX and Blue Origin are now in a space race that is similar to the 1960s U.S. versus U.S.S.R. (Russia) race to the moon. Both SpaceX and Blue Origin are developing reusable rockets that can use their engines to perform a controlled descent to a vertical landing at the same location that they originally blasted off into space. They have the same goal, which is to develop a rocket system that is as reliable and reusable as an airplane. Billionaire Elon Musk is the founder of Tesla Motors and SpaceX and billionaire Jeff Bezos is the founder of Amazon.com and Blue Origin.

SpaceX was first to successfully perform a vertical landing when it landed its Falcon 9 rocket on December 22, 2015. The SpaceX news release on this flight indicated that

before the landing their Falcon 9 rocket delivered 11 satellites into low earth orbit. Photo 1 shows the night vertical landing of the Falcon 9 rocket. Photo 2 shows two light streaks that were made by this rocket; one when it launched and the second when it vertically landed. Notice that it landed almost exactly in the spot at the Cape Canaveral Launch Complex from which it took flight.

As I am writing this, Blue Origin is currently ahead in the race when it comes to repeating vertical landings. One of the two successful launches and landings of the same New Shepard rocket is shown in Photo 3; Photo 4 shows one of its two successful vertical landings.

To be clear, the rocket in these pictures was flown to the edge of space and then used its engines to perform a controlled vertical landing. Once back on the ground, it was checked out and refueled and 61 days later it did the exact same launch and controlled vertical landing all over again. You can watch a Blue Origin video of these two take offs and landings at [www.youtube.com/watch?v=74tyedGkoUc](http://www.youtube.com/watch?v=74tyedGkoUc)

Competition between these two companies, and other private companies that are also now in the space race, should speed up the process of developing new technologies for the exploration of space. All of these companies see space exploration and space tourism as a future enterprise that will eventually be worth billions, if not trillions, of dollars.

The mission goals of SpaceX and Blue Origin are different, so one can expect the lead in this space race to ebb and flow between them and perhaps even shift to other new competitors that have entered the race. The SpaceX Falcon 9 rocket is physically much larger and more powerful than the New Shepard rocket because it is designed to launch satellites into earth's orbit. The New Shepard rocket is much smaller because it is designed to

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**Photo 1—The Falcon 9 moments before it completed its landing. Notice the protruding tripod legs that help stabilize the rocket once it is resting on the ground.**

YouTube video that highlights his speech and the technology that took us to the moon is located at [www.youtube.com/watch?v=vMtjnrBcHdI](http://www.youtube.com/watch?v=vMtjnrBcHdI).

Today only government funded agencies, like NASA, can afford to constantly build non-reusable hardware to venture into outer space. For space flight to become as common-



**Photo 2 —One of the streaks of light was created by the launching of the Falcon 9 and the other was created by its landing on the same platform.**



Blue Origin

**Photo 3 –The New Shepard Rocket blasting off into space**

only perform sub-orbital flights for space tourism. Jeff Bezos has indicated that the landing capabilities of New Shepard will soon be scaled up to much larger rockets.

The Apollo 17 mission to the moon was the last time space travel took people beyond low earth or-

bit. I have always wondered if a worthy competitor in the 1970s continued to pursue travel to the moon, would we now have a permanent space station there instead of one in low earth orbit? Competition has always been a driving force for human accomplishments.

Perhaps this new space race will help place future astronauts back on the moon. Perhaps it will also be a driving force that takes people to Mars. Time will tell if new competitors will help us move back into space to perform the missions once foretold in science fiction books, comics, and movies.

**Recalling the Facts**

1. Once the rocket vertically landed back on its launch pad, why wouldn't it be ready to fly again almost instantly after it was refueled?

2. How many years do you think it will take for rockets to be as reliable and fully reusable in almost the same turnaround time to the next flight as an airplane? Why? ☺



Blue Origin

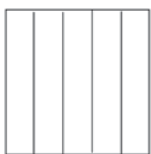
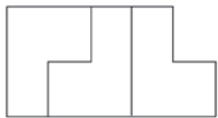
**Photo 4 –New Shepard Rocket vertically landing. Its touchdown was at 4.2 mph.**

**More than Fun Answers**

**On a First-Name Basis**

1. D—ALLEN wrench
2. B—Plumb BOB for transit
3. E—Drill motor CHUCK
4. A—GUY wire for mast
5. C—Auto JACK

**Divide and Conquer**



**Figure It Out**



Cover the left half of each figure with a sheet of paper and you'll see that the figures are just that—numerical figures.

**A Class Act**

There were 11 students in one group and 19 in the second group.  
( $x + x + 8 = 30$ )

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