

*Easily digestible Aerospace Principles revealed for K-12 Students and Educators. These lessons will be sent on a bi-weekly basis and allow grade-level focused learning. - AIAA STEM K-12 Committee*

## GEMINI VIII

Fifty years ago, on March 16, 1966, Gemini VIII (Gemini 8) was launched into orbit around the earth. It had a two-man crew: Neil Armstrong (later the first person to set foot upon the moon) and David Scott. Project Gemini was a series of twelve launches, ten of them manned, to develop the technology and the techniques to allow a manned mission to the moon and back. Gemini VIII was the first time a spacecraft had docked with another spacecraft in orbit; it was also the first in-orbit emergency in the American space program that endangered the lives of astronauts.

### GRADES K-2

During the emergency on board the Gemini 8 the ship began to spin rapidly. While they tried to correct the problem, the spinning became so bad that the astronauts almost passed out. Can you imagine how they felt? Maybe you have been on a ride at the fair or a theme park that whirls you around and around. What happens when you stop? Are you dizzy? Do you wobble a bit when you try to stand still? What causes the feeling of dizziness? Here is a simple explanation: <https://www.highlightskids.com/science-questions/why-does-spinning-make-you-dizzy> . Try it now; just spread your arms and twirl in circles. Now stop and try to walk in a straight line. Is it hard? Think of how difficult it would be for the astronauts to operate the controls of the spacecraft, or concentrate on what they needed to do next.

Here are the directions for a fun game to play during recess or PE that illustrates how difficult it is to do things while you are dizzy: <http://www.imom.com/15-backyard-game-instructions/#.VkSjQberQdU>.

Another problem the astronauts faced is called the Coriolis force. You may have felt this while spinning in an office chair. There you are spinning around and, when you reach for something, it feels like your arm is pulled off course. You can also feel it if you are in a spinning chair and let your arm hang down and swing forward and backward. Imagine how hard it must have been for those astronauts as their whole spacecraft rotated and they were trying to push the right control buttons! A fairly simple explanation of Coriolis force and how it relates to space travel can be found here: [http://science.nasa.gov/science-news/science-at-nasa/2004/23jul\\_spin/](http://science.nasa.gov/science-news/science-at-nasa/2004/23jul_spin/).

### **GRADES 3-5**

Crew member Gordon Cooper of the Gemini 5 proposed that the mission be commemorated with a mission patch similar to the military patches worn by USAir Force pilots on their flight suits. Since that time a patch has been designed for every NASA mission. The design may include things like the names of crew members, the mission's name and number, and images that symbolize the mission's objectives.

There are lists of the various patches here [http://history.nasa.gov/mission\\_patches.html](http://history.nasa.gov/mission_patches.html) and here [https://en.wikipedia.org/wiki/Mission\\_patch](https://en.wikipedia.org/wiki/Mission_patch). For a complete list of the Gemini missions, the crew members, and images of their patches, check here [https://en.wikipedia.org/wiki/Project\\_Gemini](https://en.wikipedia.org/wiki/Project_Gemini). If you were going on a mission in space, what do you think your goals and objectives would be? How would you represent that in a mission patch?

### **GRADES 6-8**

Project Gemini was the first attempt by the United States to work in space. Gemini spacecraft were launched in 1965 and 1966; you can find a chronology of the project here: <http://history.nasa.gov/SP-4002/contents.htm>

Several things that Project Gemini pioneered are now commonplace:

- Extravehicular Activity – going outside the spacecraft to work was first done on Gemini IV. The astronauts found that without any place to stand or hold on to, trying to turn a bolt would instead turn the astronaut.
- Long-Duration Missions – Gemini VII lasted fourteen days; the longest manned American space mission before Gemini lasted only a day and a half.
- Rendezvous and Docking – The Gemini VI and Gemini VII capsules flew within a foot of each other and stayed within 300 feet of each other for about five hours. Gemini VIII, XI, and XII docked with specially-launched Agena rockets.

One thing that was not in the Gemini project plan was that astronaut John Young smuggled a corned beef sandwich on board Gemini III. You can read about it here:

<http://news.discovery.com/space/the-case-of-the-contraband-corned-beef-sandwich.htm>

## GRADES 9-12

Project Gemini was a stepping-stone on the way to placing people on the moon. President John Kennedy, in a speech on May 25, 1961, set the goal “before this decade is out, of landing a man on the moon and returning him safely to the earth.” At that time, the United States had placed only one person in space (Alan Shepard’s suborbital flight of May 5, three weeks earlier) and had never placed a person in orbit. The Soviet Union had placed the first satellite in orbit around the earth (Sputnik I); the Soviet Union had placed the first astronaut into orbit around the earth (Vostok I); the Soviet Union had sent the first spacecraft towards the moon (Luna I), to the moon (Luna II, which crash-landed), and around behind the moon (Luna III). President Kennedy was declaring a race to put the first person on the moon—and bring him safely home. You can find more information and a recording of President Kennedy’s speech here:

<http://history.nasa.gov/moondec.html>

For an interesting illustration of the dynamics of a spinning body, you can put a rubber band around a book (or take some other means to keep it from flying open) and toss it up in the air in front of you, making it spin about one of its axes. If you spin it about its longest axis (usually from the top of the book to the bottom of the book), it spins stably; it may wobble slightly but not by much. Similarly, if you spin it about its shortest axis (from the center of the front cover to the center of the back cover), it spins stably. If you spin it about its intermediate axis (usually from the spine to the side opposite the spine), though, the book will spin unstably; it will tumble about as it is spinning. (When the students get to college and take a course in three-dimensional dynamics, they can solve the equations of motion to demonstrate why this happens.) In the same way, the Gemini capsule was not spinning smoothly about a single axis; it was tumbling wildly in space.

Coincidentally, the launch of Gemini VIII on March 16, 1966 happened on the fortieth anniversary of Robert Goddard’s first liquid-fueled rocket launch in 1926. Mr. Goddard’s rocket reached an altitude of 41 feet, flew for two seconds, and had an average speed of about 60 miles per hour. A short article on Robert Goddard can be found here:

[http://www.nasa.gov/missions/research/f\\_goddard.html](http://www.nasa.gov/missions/research/f_goddard.html)