



Virtual Learning

# Aerospace Engineering

**Composite Materials**

April 15, 2020



# Aerospace Engineering

## Lesson: April 15, 2020

### **Objective/Learning Target:**

students will examine some of the materials used in the field of aerospace.



## **Bell Work:**

What type of materials do you think are used to construct a space shuttle?



## Let's Get Started:

### Watch Videos:

- [Space Shuttle Thermal Tile Demonstration](#)
- [How To Make NASA's Space Tiles](#)

# Composite Materials

## Definitions You Need to Know:

**Carbon Fiber** - An extremely strong fiber, made of long, chain-like molecules of almost pure carbon, that are made by burning fibers such as rayon in the absence of oxygen.

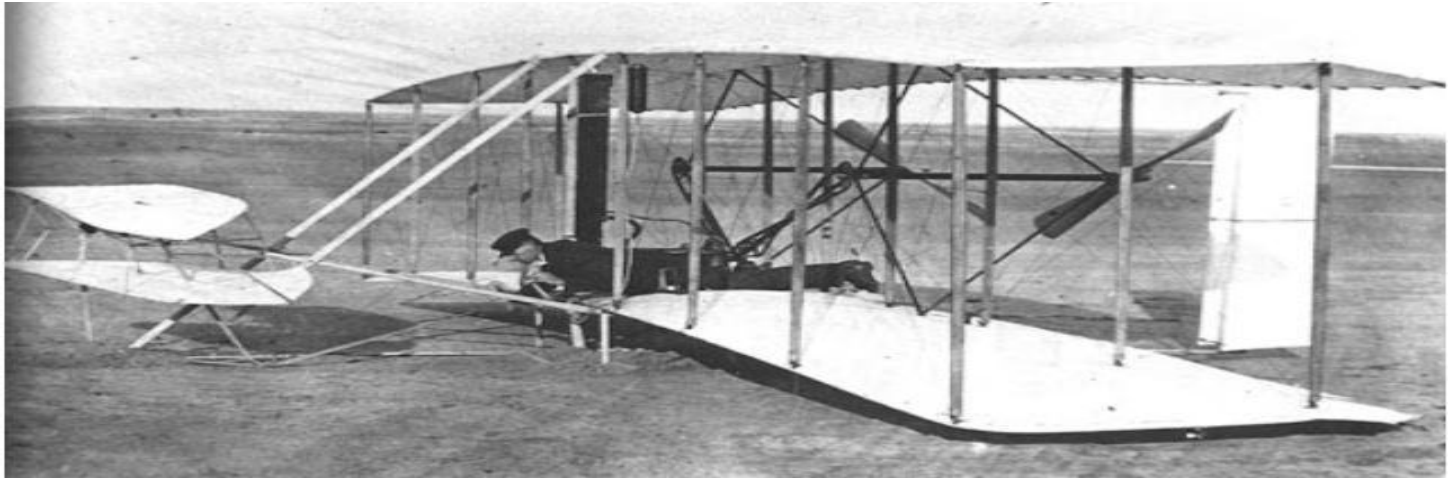
**Density** - A measurement of the compactness of a material, measured in terms of mass per unit of volume

**Shape Memory Alloy (SMA)** - An alloy that because a process of extensive heating forms an assigned shape

**Nitinol** - a nickel-titanium alloy distinguished from other materials by its shape memory and superelastic characteristics.

## Materials in Aerospace

Since the Wright brothers built the Wright Flyer in 1903, the materials used to build airplanes have been constantly evolving. The original Wright Flyer was made primarily of spruce and ash wood, with muslin (a cotton fabric) covering the wings. Today's planes are made mostly of aluminum with some parts made from steel.





# Materials in Aerospace

In the 1960's, scientists and engineers began working on new types of aerospace materials called composites. A composite is an engineered material made from two or more materials with different properties, either physical or chemical.

An example of one of the first composite materials ever made was a mix of mud and straw that was used to make bricks. Two significant advantages over some of materials is greater strength and lighter weight.



# Materials in Aerospace

One of the more common composites in use today is carbon fiber. It is made by heating lengths of rayon or other types of fiber to extremely high temperatures (2000 C/3632 F) in an oxygen-deprived oven. This combined with the lack of oxygen, means that instead of burning completely, the rayon strands turn into strands of pure carbon atoms approximately six micrometers in diameter. These strands are spun into a thread, then woven into sheets and mixed with hardening resins to form the components needed.





## Thermal Protection System (TPS)

Space shuttles that enter the atmosphere require the use of a thermal protection system (TPS) to protect them from overheating. The heating is generated at the surface of an object due to the combination of compression and surface friction of the atmospheric gas. The space shuttle features a TPS system based on the use of surface materials with a high temperature threshold in combination with thermal insulation to keep the of heat from the interior of the shuttle. The heat developed from the heating process is redirected back into space. The front edges of the wings and nose cap have the most heat put on them. The materials used on these parts have been the subject of a lot of research. They are always trying to enhance the capabilities of these materials. They are always trying to make these more durable and more resistant to higher temperature.



# Materials Understanding

1. Research the Wright Flyer on the internet. Be sure to look at photos of the plane. Then list the materials used in the airplane's construction.
2. Why do you think the Wright brothers chose those materials.
3. Research the Boeing VC-137C (Boeing 707) on the internet. Be sure to look at photos of the plane. Then list the materials used in the airplane's construction.
4. Research the Space Shuttle Challenger on the internet. Be sure to look at photos of the shuttle. Then list the materials used in the airplane's construction.