



## AIRCRAFT PUZZLES: JUNIOR ENGINEERING TEAMS

*Students will learn about the history of humanitarian airlift missions as well as the dynamics of working and solving problems as a member of a junior engineering team. The U. S. Air Force's Global Reach is emphasized.*

### LESSON PLAN

#### Learning Objectives

The students will

- Using the outline of a facsimile of a C-17 cargo aircraft, learn the main parts of an aircraft and their function
- Using the facsimile outline of the cargo area of a C-17, learn and practice the role of a loadmaster on a two dimensional scale
- Learn about the dynamics of solving problems while working in a team environment
- Learn about the history of some USAF humanitarian airlift missions around the world
- Learn about the variety of cargo and refueling aircraft which have been used throughout recent history
- Learn about the U. S. Air Force's successful development of "Global Reach and Global Power"

#### Background

The U. S. Air Force was not a separate branch of the U. S. military until 1947. However, from its very beginnings as a distinct entity, the Air Force has NOT just used its airlift capabilities to transport combat troops and supplies into, and out of, theaters of war (as exemplified by Operation Desert Storm, one of the largest strategic airlifts since World War II). Humanitarian airlift efforts have always been a key component and top priority for the Air Force, and these missions have made an extremely positive impact on the lives of countless individuals around the world. For example, in June 1948, when the Air Force was still in its infancy, the Soviet Union decided to block all roads, railways and rivers going into the city of West Berlin (which was still in ruins after World War II). They cut all power as well, so the 2.5 million inhabitants of West Berlin faced certain starvation. There were, however, three narrow air corridors left open, as the Soviets thought the Allies' airlift capabilities would be negligible. The United States, Britain and France agreed to join forces to keep West Berliners supplied with coal and food, and above all, to keep them free from Soviet rule. The Berlin Airlift, nicknamed "Operation Vittles," lasted for fifteen straight months, and nearly 2.3 million tons of supplies (4.6 billion pounds) were flown into Berlin during 277,000 flights (there was one flight every three minutes)!

**Grade Level:** K - 3

#### [Ohio Learning Standards/Technology \(2017\)](#)

*Design and Technology*

[K-2.DT.3.b](#): Working as a team

#### [Ohio Learning Standards/Social Studies \(2018\)](#)

*History Topics:*

[Historical Thinking and Skills](#)

[Heritage](#)

*Geography Topics:*

[Spatial Thinking & Skills](#)

#### [Ohio Learning Standards/Science \(2018\)](#)

*Expectations for Learning*

[Nature of Science](#)

#### [Ohio Learning Standards/Mathematics \(2017\)](#)

*Ohio Standards for Mathematical Practices*

[MP.1](#): Make sense of problems

[MP.4](#): Model with mathematics

[MP.5](#): Use appropriate tools strategically

[MP.7](#): Look for and make use of structure

*Geometry*

[K.G.6](#): Combine simple shapes to form larger shapes

[1.G.2](#): Compose 2-d shapes to create a composite shape

#### **Materials Required:**

- Laptop, monitor, digital projector, Internet access
- Demo items as listed within lesson plan
- Laminated copies of the three drawings included in this lesson plan
- 3-D Model of a C-17 if available

The workhorses for this incredible humanitarian airlift were C-47s and C-54s, and that is what makes this whole airlift operation so amazing—none of the gigantic cargo aircraft of today, such as the C-17 “Globemaster III,” the C-5 “Galaxy” and the C-130 “Hercules,” were in existence yet! More recently, the Air Force has been heavily involved in global humanitarian airlift missions, which provide relief and assistance to victims of civil war, famine, floods, earthquakes, wildfires, harsh winter weather, etc. Some of the countries that have benefitted from these humanitarian operations include Somalia, Bosnia, Kosovo, Greece, Peru, Ecuador, Venezuela, the former Soviet Republics, Rumania, Rwanda, Iraq, Turkey, Mozambique, Madagascar, Pakistan, India, Japan, Haiti, Honduras, El Salvador, Nicaragua, Afghanistan and Indonesia! Some of our states that have benefitted from the Air Force’s humanitarian efforts include Oklahoma, Kansas, South Dakota, Louisiana, Hawaii, California and Florida. In 1992, the Air Mobility Command (AMC) was formed. AMC is a major command which provides worldwide cargo and passenger delivery, air refueling and aeromedical evacuation. It is also the command which is the focal point for all Air Force humanitarian airlift operations. With regard to air refueling operations, the two primary aircraft that allow the Air Force to have such amazing “Global Reach” are the KC-135 “Stratotanker” and the KC-10 “Extender.” They extend the range of our tactical fighters and strategic bombers during overseas operations, and they also provide refueling support to the Navy, the Marine Corps and many aircraft of our allied nations. Not only do these aircraft play a key role in the mobilization of our military assets, they are also capable of transporting litter and ambulatory patients utilizing patient support pallets during aeromedical evacuations. Regarding modern cargo aircraft, such as the C-17 and the C-5, their inherent performance and flexibility greatly improve the ability of the Air Force’s ‘total airlift system’ to fulfill its global air mobility requirements. These requirements have increased significantly, since the size and weight of U. S. mechanized firepower and equipment have grown in response to the improved capabilities of our potential adversaries. Finally, the ultimate measure of airlift efficacy is the ability to rapidly project and sustain an effective combat force in close proximity to a potential theater of war. Most assuredly, the U. S. Air Force has that ability. And, its proficiency in providing humanitarian aid is beyond repute.

### **Procedures:**

- Before class, prepare the following for each team: (1) copy and laminate the enclosed facsimile of a C-17 cargo plane; cut the plane into different sized puzzle pieces based on the grade and ability level of the students; (2) copy and laminate the outline of the cargo area; and (3) copy the “floor plan” of the cargo area of the plane, laminate and cut apart into 12 pieces as drawn. Please ensure that both the floor plan and the pieces that fit into it are a total of 5.5 inches wide and 9 inches high.
- If available, show the students a model of a C-17 Globemaster III cargo airplane. If not available, show the students photos and/or the video (both available at the web sites in the resources section below). Explain that the aircraft has a huge cargo capacity (170,900 pounds maximum payload). Explain that all aircraft, even the huge C-17, has to have the cargo loaded very carefully to keep the plane balanced and flying safely.
- Divide the students into teams of about five students and explain the value of learning to work as a team. All engineers work on teams with individuals having different responsibilities and skills.
- Show the students the outline of a facsimile of a C-17 cargo plane (included) and discuss the main parts of a plane: cockpit, fuselage, wings, tail and engines. Ask the students to speculate the function of each. Discuss. See the website listed in the resource section for background information.
- Have students work together to reassemble the plane. Have a different student be responsible to describe each part and its function. Make sure that students are aware that the fuselage – the main body of the aircraft – is the area in which cargo (whether people, materials or equipment) are loaded. Depending on the students’ grade level, you may want to allow them to see (or actually possess) a copy of the completed puzzle as they work.
- Encourage team members to talk and communicate their ideas with one another until the aircraft is put back

together correctly, allowing as much or as little time as the abilities of the students allows.

- Next, explain to the class the role of the loadmaster. See the website listed in the resource section for information and videos. Emphasize that this is a very important job that requires skills in many areas, especially math. Students will now have the opportunity to practice being loadmasters on a two dimensional scale. The job, of course, is much more complicated on a three dimensional scale.
- Distribute the cargo pieces and the cargo floor outline to each of the teams. Show the class the perimeter/outline of the cargo floor and tell the students that their goal as aircraft loadmasters is to work together as a team to carefully plan and correctly place all 12 pieces so that they fit perfectly onto the cargo aircraft's floor. There is more than one possible configuration.
- Again, allow students as much or as little time to accomplish this task as dictated by their grade level and abilities. Remind them that working within the framework of a team is an important skill as future engineers (as well as in many other endeavors).

### **Assessment/Evaluation**

The students should be evaluated on their class participation, listening skills and their ability to follow verbal instructions, especially when they are involved as cooperative learning members of a junior engineering team!

### **Resources**

C-17 resources:

<https://www.af.mil/About-Us/Fact-Sheets/Display/Article/1529726/c-17-globemaster-iii/>  
<https://www.boeing.com/defense/c-17-globemaster-iii/>  
<https://www.youtube.com/watch?v=kbbKz7ecoRc>

USAF Humanitarian missions:

<https://www.airforce.com/mission/american-airmen/humanitarian>  
<https://www.airforce.com/mission/history>

Loadmaster information:

<https://www.airforce.com/careers/detail/aircraft-loadmaster>  
<https://www.thebalancecareers.com/1a2x1-aircraft-loadmaster-air-force-enlisted-job-3344243>  
<https://www.af.mil/News/Features/Display/Article/142784/understanding-life-as-a-loadmaster/>

Parts of an aircraft:

<https://www.grc.nasa.gov/www/k-12/airplane/airplane.html>

Other National Museum of the USAF relevant resources:

<https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/196271/douglas-c-47d-skytrain/>

<https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/196682/c-47-hospital-ship/>

<https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/197518/berlin-city-held-hostage/>

<https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/617087/global-reach-gallery-introduction/>

<https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Global-Reach-Gallery/>

<https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195851/boeing-c-17-globemaster-iii/>

General Information:

- [https://www.centennialofflight.net/essay/Air\\_Power/cargo/AP19.htm](https://www.centennialofflight.net/essay/Air_Power/cargo/AP19.htm)
- [https://www.theaviationzone.com/factsheets/c5\\_fun.asp](https://www.theaviationzone.com/factsheets/c5_fun.asp)
- [https://www.theaviationzone.com/factsheets/c5\\_specs.asp](https://www.theaviationzone.com/factsheets/c5_specs.asp)
- <https://www.theaviationzone.com/factsheets/c17.asp>
- <https://www.theaviationzone.com/factsheets/c130.asp>
- [https://www.grc.nasa.gov/www/k-12/WindTunnel/Activities/balance\\_of\\_forces.html](https://www.grc.nasa.gov/www/k-12/WindTunnel/Activities/balance_of_forces.html)
- <https://www.grc.nasa.gov/WWW/K-12/airplane/acg.html>
- <https://www.amc.af.mil/>





