NATIONAL MUSEUM OF THE UNITED STATES AIR FORCE

AIRLIFT MISSION—JUNIOR ENGINEERING TEAMS

Students will learn about the history of airlift missions (both humanitarian and combat) as well as to learn about 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 PLANS "O" and "P"

Learning Objectives
The students will

- Learn about the structural outline of a C-17 cargo aircraft, as well as the basics of arranging cargo, while working in cooperative learning/engineering teams
- Learn about the dynamics of solving problems while working in a cooperative learning team environment (an objective outlined within National Academic Standards for early grades is: students should become more adept at learning from, and working with, others
- Learn about the history of both humanitarian and combat 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"

Introduction/Background

Airlift and transport missions were not a real priority during the early years of flight, primarily because the small aircraft at the time were not conducive to large cargo loads or multi-passenger movement. As airplanes developed and their size and capacity increased, airlift operations became a reality. The very first successful airlift was accomplished by Germany in 1936, when they transported 20,000 stranded Spanish troops across the Strait of Gibraltar and on to Seville, Spain. It took the Germans 677 flights (sorties) using their modified Junkers Ju.52 trimotor aircraft. After hearing the news of this successful, initial airlift, other countries began developing their own cargo/transport Aircraft. The British utilized transport-bombers, such as Their Vickers Victoria airplane. The United States developed transports that were actually Douglas DC-3 and Douglas DC-4 commercial airliners, and with modifications, these two aircraft became C-47 "Skytrains" and C-54 "Skymasters," respectively. The conversions included removing the airliner interiors, adding heavier floors and creating large cargo doors. C-47s were affectionately called "Gooney Birds," and the Army Air Corps first ordered these cargo airplanes in 1940. By the end of World War II, over 9,300 "Skytrains" had been procured. C-54 "Skymasters" could carry much heavier loads than the C-47s (28,000 pounds of cargo versus 6,000 pounds) and the U. S. military (the Army Air Corps and Navy) began using C-54s in 1942.

Grade Level: 2—4
National Science Education Standards:
Science as Inquiry, Science and Technology, and History and Nature of Science

National Standards for History:
Chronological Thinking and Historical Comprehension

National Standards for Mathematics:
Geometry, Problem Solving and Communication

Technology Education Standards (ITEA):
Understanding/appreciating engineering design

Materials Required:

- Magic board and markers
- PowerPoint presentation
- Laptop, monitor, digital projector
- Demo items as listed within lesson plan

Resources:

- General Information:

http://www.amc.af.mil/library/factsheets/factsheet.asp?id=229 and id=239 and http://www.centennialofflight.gov/essay/Air_Power/cargo/AP19.htm and http://www.futurefirepower.com/us-air-force-airlift-global-us-military-aircraft and http://www.theaviationzone.com/factsheets/c5.asp (and c17.asp and c130.asp) and www.konnections.com/airlift/berlin.htm and www.caa.govt.nz and http://www.grc.nasa.gov/WWW/k-12/WindTunnel/Activities/balance_of_forces.html and http://avstop.com/technical/weightbal.htm and http://www.dod.mil/execsec/adr96/airforce_report.html and http://www.af.mil/information/factsheets/index.asp and http://www.Airforce.com/learn-about/history/part4/ and http://www.answers.com/topic/air-mobility-command and http://www.grc.nasa.gov/WWW/K-12/airplane/acg.html and www.nationalmuseum.af.mil/education

From 1942 through 1947, the Army Air Corps procured 1,164 C-54 "Skymasters." Special Note: 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 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)! 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! 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 Military Transport Service (airlift division) merged with Strategic Air Command's refueling operations to form the Air Mobility Command (AMC). AMC is a major command which is headquartered at Scott Air Force Base in Illinois, and it 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:

NOTE: Teachers may use as much of the information contained within the "Intro/Background" section as they deem appropriate for their students; similarly, teachers may wish to pick and choose items within this "Procedures" section. Teachers may wish to divide their class into four, five or six teams of five students each prior to commencing these lesson plans. Again, an important goal outlined within National Academic Standards for earlier grades is that students should become more adept at learning from, and working with, others!
Background PowerPoint is at http://www.nationalmuseum.af.mil/shared/media/document/AFD-121218-021.pdf.

- Write (on board) the things that will be covered/discussed/reviewed in class, including: the overall outline or structure of a C-17 cargo airplane, the basic idea behind planning and loading cargo into an aircraft, engineering teams working to solve problems, the history of airlift operations, the various types of aircraft used for airlift missions and a PowerPoint presentation. **LESSON PLAN "O" :**
- Hook: hold up a copy of the C-17 outline/shape found on page 5 (Teacher Addendum) of this lesson plan, and also show the PowerPoint slide of the C-17 "Globemaster III" on a screen/ TV/monitor. Tell the students that each engineering team will be receiving a copy of the C-17 illustration/shape, as well as another one which has been cut into multiple pieces (you may wish to copy it on cardstock or laminate it before cutting it apart).

Procedures (continued)

- For second graders, it would be best to keep both wings intact (including the engines) and the tail section should be kept as one unit. The fuselage (body) however, may be cut into three, four or five different pieces, using both straight cuts and diagonals—it is totally up to you!
- For third and fourth grade students, you may wish to cut the wings and the tail section into two, three or four pieces, so that there may be as many as 12 to 13 different 'puzzle pieces' for teams to put back into the original C-17 structure. If you decide to REALLY challenge a fourth grade class, separate each engine as well (potentially having 16 or 17 individual pieces).
- Distribute the sheet with the intact structure (for teams to use as a guide) as well as one that has been cut into pieces.
- **Special Note:** National Science Academic Standards/Science As Inquiry/Evidence, Models and Explanation: models (either 2-dimensional or 3-dimensional) correspond to real objects and help both scientists and students understand how things work!
- Tell the teams that their objective is to put the 'puzzle pieces' together correctly.
- Each team should have the same number of pieces, and team members may chose to put the pieces over the sheet containing the whole aircraft outline/structure.
- Walk around the classroom and assist only when absolutely necessary.
- Encourage team members to talk and communicate their ideas with one another until the aircraft is put back together correctly! Allow junior engineering teams plenty of time to complete their assembly task.
- When all teams have their C-17 assembled properly, congratulate them and collect the puzzles and outlines.

END OF LESSON PLAN "O"

- **LESSON PLAN "P" :**
- Tell the class that you are now going to add an aircraft loadmaster "hat" to their engineering team "hat!"
- Tell them that, since they know how to "build" a C-17 "Globemaster III," the teams are now going to work cooperatively to plan how to load 'cargo' onto an aircraft!
- For older students, you may wish to cover loadmaster duties as outlined on page 3 of Lesson Plan "E."
- Prior to the class, you may wish to copy the Teacher Addendum (found on page 6 of this lesson plan) onto cardstock, or laminate copies of the 'cargo' and cargo 'floor.' You may wish to erase/white out the shape outlines on a master copy, and use the remaining 'floor' perimeter to make copies for the teams. You may also wish to simply draw the perimeter of the cargo floor (as shown on page 6) separately—please ensure that your drawing is 5.5 inches wide and 9 inches high (so as to accommodate the 12 cargo shapes).
- Show the class the perimeter/outline of the cargo floor, and tell them that each engineering team will receive a copy of this outline to use as their cargo loading guide!
- Each team will also receive the pieces of 'cargo' that you've already cut out during your class prep.
- If you wish, you may copy and cut the 12 pieces from page 6, or you may design your own geometric cargo shapes—just so they fit within the 5.5-inch by 9-inch cargo floor perimeter!
- Distribute the cargo pieces and the cargo floor outline to each of the teams.
- Tell the students that their goal as aircraft loadmasters is to carefully plan, and correctly place, all 12 pieces, so that they fit perfectly onto the cargo aircraft's floor.
- Tell them that there are several correct placement possibilities!
- Helpful hint for Junior Engineering Teams: team members should keep the printed 'star' symbol face up as they plan their loading strategy!
- Walk around the classroom and assist only when necessary.
- Encourage team members to talk with one another, and to communicate ideas until their cargo is loaded.
- **Teacher's Note**: Within the National Standards for Mathematics (Geometry) students will be using spatial reasoning and logic, visualization and geometric modeling during both Lesson Plan "O" and Lesson Plan "P."
- When all teams have their cargo floors/aircraft loaded properly, congratulate them and collect the pieces and outline sheets.
- Lead a class discussion about what your students thought about each of the two junior engineering team experiences they had in Lesson Plan "O" and in Lesson Plan "P" (ask them which activity they enjoyed the most—and why).
- Once again, congratulate students on becoming successful aerospace engineers and aircraft loadmasters! Tell them that cooperative learning and working within the framework of a team are important skills that will be very helpful to them as future students, as well as in their adult lives!

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!

References

The C-47: Flying Workhorse of WWII by Richard D Harvey; Bloomington, IN: Author House; 2005

C-54-PLM Revisited by Ralph L. Stevenson, Jr; Sante Fe, NM: Sunstone Press; 2010

Humanitarian Airlift Operations by Daniel L. Haulman; Washington, DC: U. S. Printing Office; 1998

The Lockheed Martin c-130 Hercules by Peter C. Smith; Manchester, England: Crecy Publishing Ltd.; 2010

The "C" Planes: U. S. Cargo Aircraft 1925 to Present by Bill Holder & Scott Vadnais; Atglen, PA: Schiffer Publishing Ltd.; 1996

The Boeing C-135 Series: Stratotanker, Stratolifter and other Variants by Don Logan; Atglen, PA: Schiffer Publishing Ltd.; 1998

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