OKLAHOMA Aeronautics

TOOLKIT 6

# LET'S BUILD A TABLETOP AIRPORT

OKLAHOMA CareerTech

**Overview:** Students will design and build a model airport, learn the components of an airport and use the tabletop model to demonstrate airport operations.
**Source:** *Aeronautics Educator Guide*, NASA
**Grade Levels:** 2-4
**Location:** https://www.nasa.gov/stem-ed-resources/aeronautics.html

| 1<br>Student Activity | 2<br>Lesson Plan or Procedure | 3<br>Activity Evaluation or Rubric | 4<br>Suggested Activities | 5<br>Glossary | 6<br>Teacher Background or Concepts | 7<br>Student Background or Concepts | 8<br>Standards Alignment |
|---|---|---|---|---|---|---|---|
| | x | x | x | | x | | x |

Notes:
- Includes assessment options.
- Includes a materials list.
- Includes extension activities.

KEY:

1. Student Activity: This is the focus of the toolkit. It is at least one complete activity or lab for students to complete that relates to a topic relevant to aviation/aerospace. It may include related worksheets.

2. Lesson Plan or Procedure: These are the steps or instructions for the teacher to use to deliver the activity.

3. Activity Evaluation or Rubric: These are answers to the activity or a rubric or other tool for evaluating students' results.

4. Suggested Activities: These are additional or extension strategies for the teacher that relate to the topic/activity.

5. Glossary: This is a list of the vocabulary terms and their definitions that relate to the activity and/or associated concepts.

6. Teacher Background or Concepts: This is any background information for the teacher that explains key concepts relating to the topic/activity, provides the aerospace context for the activity or otherwise helps prepare the teacher for the topic/activity.

7. Student Background or Concepts: This is any background information for the student about theory and concepts related to the topic/activity. It may be separate handout files or a text section within the larger topic/activity.

8. Standards Alignment: Education or industry standards that align with the topic/activity.

## SUPPLEMENTAL RESOURCES

General Resources

- *Pilot's Handbook of Aeronautical Knowledge,* Federal Aviation Administration, 2016. Free to download at https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/.
- Airport Acronyms and Abbreviations, Federal Aviation Administration, https://www.faa.gov/airports/resources/acronyms/
- Find an Airport, Oklahoma Aeronautics Commission, https://oac.ok.gov/airports
- K-12 Student/Teacher Resources, NASA, https://www.nasa.gov/aeroresearch/resources/k-12-resources
- *Aeronautics Educator Guide,* NASA, https://www.nasa.gov/stem-ed-resources/aeronautics.html

Instructional Practice Resources

- *60 Formative Assessment Strategies*, Natalie Regier, 2012. Free to download at https://www.okcareertech.org/educators/resource-center/teacher-trainer-tools.
- *Student Learning That Works: How brain science informs a student learning model,* McREL International, 2018. Free to download at https://www.mcrel.org/student-learning-that-works-wp/.

Career Planning Resources

- OK Career Guide. Free to Oklahoma educators. For more information, see https://www.okcareertech.org/educators/career-and-academic-connections/ok-career-guide.
- Aviation Organizations, Oklahoma Aeronautics Commission, https://oac.ok.gov/media-outreach/aviation-organizations
- *Careers in Aerospace,* American Institute of Aeronautics and Astronautics. Free to download at https://www.aiaa.org/get-involved/students-educators/Careers-in-Aerospace.
- Flying for a Career, AOPA, https://www.aopa.org/training-and-safety/learn-to-fly/flying-for-a-career
- Oklahoma Aerospace: Building on a Rich Tradition, Oklahoma Department of Career and Technology Education, https://www.okcareertech.org/business-and-industry/aerospace-and-aviation

Activity-Specific Resources

- Find an Airport, Oklahoma Aeronautics Commission, https://oac.ok.gov/airports
- "Airport," Britannica Kids, https://kids.britannica.com/students/article/airport/272760

# TEACHER BACKGROUND INFORMATION
# AIRPORT OPERATIONS

**Airport Basics**

An airport is a facility where passengers connect from/to ground transportation to air transportation. At the very minimum, an airport consists of one runway (or helipad), but other common components are hangars and terminal buildings. An airport may also have operator services; air traffic control; passenger facilities such as restaurants and lounges; and emergency services.

A military airport is known as an *airbase* in North America. The terms *airfield* and *airstrip* may also refer to a facility that has only a runway. An *aerodrome* refers to any surface used for takeoff or landing. The term airport refers to an aerodrome that is licensed by the responsible government organization (the FAA in the United States). Airports must be maintained to higher safety standards.

Airports vary in size. Smaller or less-developed airports may have only one runway shorter than 3,300 feet. Larger airports — such as those for international flights — generally have paved runways that are 6,600 feet long or longer. Many small airports have dirt, grass or gravel runways rather than asphalt or concrete runways.

Airports have *landside* and *airside* areas. Landside areas include parking lots, fuel tank farms and access roads. Airside areas include all areas accessible to aircraft, including runways, taxiways and ramps. Access from landside areas to airside areas is tightly controlled at most airports. Passengers on commercial flights access airside areas through terminals, where they can purchase tickets, clear security, check or claim luggage and board aircraft. The waiting areas that provide passenger access to aircraft are typically called concourses (this term is often used interchangeably with *terminal*).

The area where aircraft park next to a terminal to load passengers and baggage is known as a *ramp*. Parking areas for aircraft away from terminals are generally called *aprons*. Both large and small airports can be *towered* or *uncontrolled*, depending on air traffic density and available funds. Because of their high capacity and busy airspace, most international airports have air traffic control located on-site. Most international airports include shops and food courts. These services provide passengers food and drinks before they board their flights.

In addition to people, airports move large volumes of cargo 24 hours per day, seven days per week. Cargo airlines often have their own on-site and nearby infrastructure to rapidly transfer packages between ground and air modes of transportation.

Aircraft maintenance, pilot services, aircraft rental and hangar rental are most often performed by a fixed base operator. At major airports, especially those used as hubs, airlines may operate their own support facilities.

Each airport has a unique airport code. The code is often an abbreviated form of the common name of the airport, such as PHL for Philadelphia International Airport. Exceptions may occur when an airport's name is changed. For example, O'Hare International Airport in Chicago kept the code ORD, from its former name, Orchard Field. In many countries, airports are often named after a famous person or politician.

**Airport History**

The earliest airplane landing sites were open, grassy fields. The airplane could approach at any angle that provided a favorable wind direction. Early airfields were often built for the purpose of entertainment. These aerodromes had a grassy field with a hangar for storing and servicing airplanes and observation stands for visitors.

Increased aircraft traffic during World War I (1914-1918) led to the construction of regular landing fields. Airplanes had to approach these from specified directions. This led to the development of navigation aids for directing the approach and landing slope. After the war, some of these military airfields added commercial facilities for handling passenger traffic.

The first international airport to open was the Croydon Airport in South London. In 1922, the first permanent airport and commercial terminal solely for commercial aviation was built in Germany. The airports of this time used a paved apron that facilitated night flying and the landing of heavier airplanes.

The first lighting used on an airport was during the late 1920s. In the 1930s, approach lighting came into use. These indicated the proper direction and angle of descent. The colors and flash intervals of these lights became standardized. In the 1940s, the slope-line approach system was introduced. This consisted of two rows of lights that formed a funnel indicating an aircraft's position on the glideslope. Additional lights indicated incorrect altitude and direction.

After World War II (1939-1945), airport design become more sophisticated. Passenger buildings were grouped in what was called an island, with runways arranged in groups around the terminal. This arrangement allowed the facilities to expand. It also meant that passengers had to travel farther to reach their airplane.

**Airport Operations**

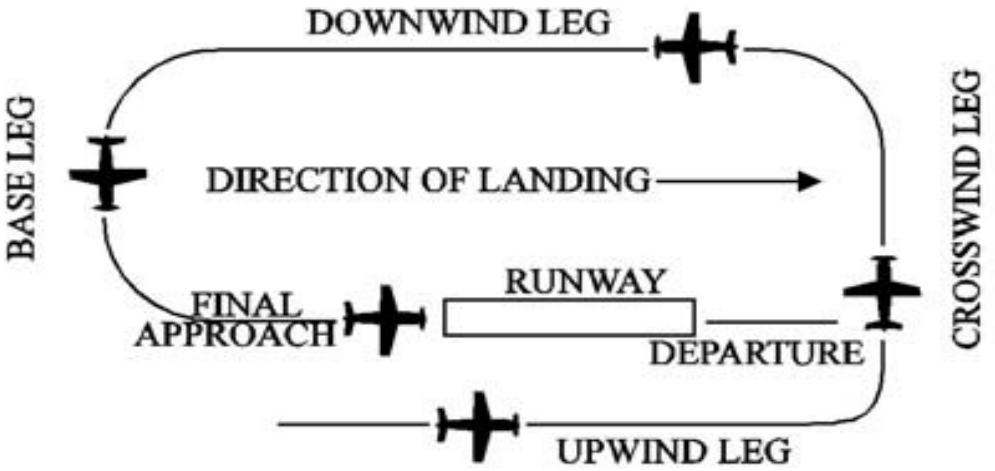
Outside the terminal, a large team of people works to ensure that aircraft can land, take off and move around quickly and safely. These processes are largely invisible to passengers but are very complex at large airports.

*Air traffic control* is a system of ground-based controllers who direct aircraft movements, usually by using push-to-talk VHF radio. This coordinated oversight facilitates safety and speed in complex operations where traffic moves in all three dimensions. Air traffic control responsibilities at airports are usually divided into ground control and tower control:

- Ground control is responsible for directing all ground traffic in designated movement areas, except the traffic on runways. This includes planes, baggage trains, snowplows, grass cutters, fuel trucks and many other vehicles. Ground control will instruct these vehicles on which taxiways to use, which runways to use (in the case of planes), where to park and when it is safe to cross runways. When a plane is ready to take off, it will stop short of the runway; tower control will then take over. After a plane has landed, it will leave the runway and be returned to ground control.

- Tower control controls aircraft on the runway and in the controlled airspace immediately around the airport. Tower controllers use radar to identify and accurately locate an aircraft's position in three-dimensional space. They coordinate the sequencing of aircraft in the traffic pattern and direct aircraft on how to safely join and leave the circuit. Aircraft that are only passing through the airspace must also contact tower control to be sure they remain clear of other traffic and do not disrupt operations.

Smaller airports and military airfields use a *traffic pattern* to make sure that traffic flows smoothly between departing and arriving aircraft. Generally, this pattern is a circuit with five legs that form a rectangle. Each leg is named. ATC directs pilots on how to join and leave the circuit.




Source: FAA *Aeronautical Information Manual*

Traffic patterns are flown at a specific altitude, usually 1,000 feet above ground level. Most traffic patterns are left-handed, meaning all turns are made to the left. (Right-handed patterns do exist, usually because of obstacles such as a mountain or to reduce noise for residents.) The predetermined circuit helps pilots look for other aircraft and helps reduce the chance of a mid-air collision.

At large airports, a circuit is not usually used. Instead, ATC schedules aircraft for landing while they are still hours away from the airport. Pilots can then take the most direct approach to the runway and land without worrying about interference from other aircraft. This system keeps the airspace free and is simpler for pilots, but it requires detailed knowledge of how aircraft are planning to use the airport ahead of time. As a result, it is only possible with large commercial aircraft on pre-scheduled flights.

Before takeoff, pilots check the Automatic Terminal Information Service for information about airport conditions. The ATIS contains information about weather, which runway and traffic patterns are in use and other information that pilots should know before they board the aircraft.

When flying, several navigation aids are available to pilots, though not all airports are equipped with them.

- A Visual Approach Slope Indicator helps a pilot fly a perfect approach for landing once they have found the airport.

- Some airports are equipped with a VHF omnidirectional range to help pilots find the direction to the airport. VORs are often accompanied by Distance Measuring Equipment to determine the distance to the airport.

- In poor weather, pilots use an Instrument Landing System to find the runway and fly the correct approach, even if they cannot see the ground.

Larger airports sometimes offer Precision Approach Radar. The aircraft's horizontal and vertical movement is tracked via radar, and the controller tells the pilot the position of the aircraft relative to the approach slope. Once the pilots can see the runway lights, they may continue with visual landings.

**Airport Navigation Aids**

Navigational aids include signs, lighting and wind indicators. Airport guidance signs provide direction and information to taxiing aircraft and airport vehicles and assist in safe and efficient movement of aircraft. Smaller airports may have few or no signs, relying instead on airport diagrams and charts.

There are two classes of signage at airports:

- Location signs (yellow on black background) — These signs identify the runway or taxiway the aircraft is on or entering.

- Direction/Runway Exit signs (black on yellow) — These signs identify the intersecting taxiways that the aircraft is approaching, with an arrow indicating the direction to turn.

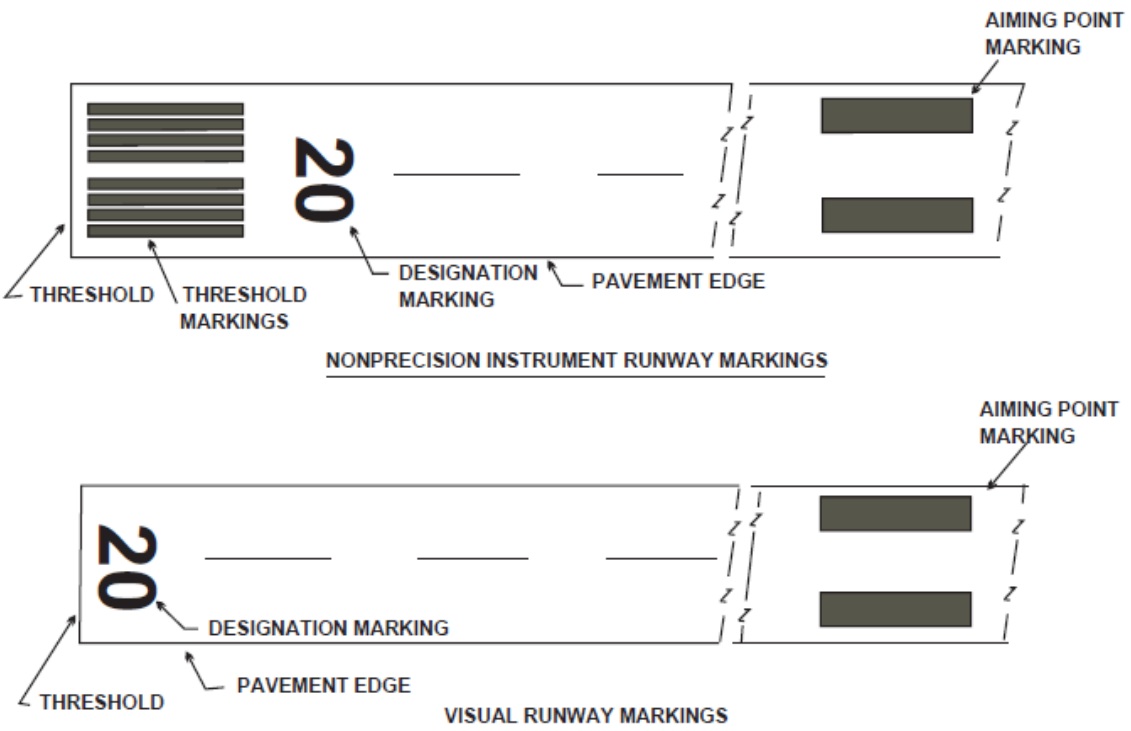
Many airports also use conventional traffic signs, such as stop and yield signs, throughout the airport.

Mandatory instruction signs are white on red. They show entrances to runways or critical areas. Vehicles and aircraft must stop at these signs until the control tower gives clearance to proceed.

- Runway signs (white on a red) — These signs identify a runway intersection ahead.

- Frequency Change signs — This is usually a stop sign and an instruction to change to another frequency. These signs are used at airports with different areas of ground control.

- Holding Position signs — A single solid yellow bar across a taxiway indicates a position where ground control may require a stop. Two solid yellow bars and two dashed yellow bars indicate a holding position for a runway intersection ahead; runway holding lines must never be crossed without permission. At some airports, a line of red lights across a taxiway indicates holding positions during low-visibility operations.




Source: FAA *Aeronautical Information Manual*

Many airports have lighting that helps guide planes using the runways and taxiways at night or in rain or fog:

- On runways, green lights indicate the beginning of the runway for landing, and red lights indicate the end of the runway. Runway edge lighting is white lights spaced out on both sides of the runway, indicating the edges.

- Some airports have more complicated lighting on the runways, including lights that run down the centerline of the runway and lights that help indicate the approach. Low-traffic airports may use Pilot Controlled Lighting to save electricity and staffing costs.

- Along taxiways, blue lights indicate the taxiway's edges. Some airports have embedded green lights that indicate the centerline.

Planes take off and land into the wind to achieve maximum performance. Wind speed and direction information is available through the ATIS or ATC, but pilots need instantaneous information during landing. For this purpose, a *windsock* is kept in view of the runway.

**Airport Safety**

Air safety is an important concern in the operation of an airport. Almost every airfield includes equipment and procedures for handling emergency situations. Commercial airfields include one or more emergency vehicles and their crews, who are specially equipped for dealing with airfield accidents, crew and passenger extractions and the hazards of highly flammable airplane fuel. The crews are also trained to deal with situations such as bomb threats, hijacking and terrorist activities.

Potential airfield hazards to aircraft include debris, nesting birds and environmental conditions such as ice or snow. The fields must be kept clear of debris using cleaning equipment so that loose material doesn't become a projectile and enter an engine duct. Similar concerns apply to birds nesting near an airfield; crews often need to discourage birds from taking up residence. In adverse weather conditions, ice- and snow-clearing equipment can improve traction on the landing strip. For waiting aircraft, equipment that sprays special de-icing fluids on the wings is used.

Source: "Introduction to Airports Design and Operations," by Lance Sherry, Ph.D., George Mason University, Center for Air Transportation Systems Research, https://catsr.vse.gmu.edu/. Adapted with permission of the author.

# TEACHER ACTIVITY REFLECTION WORKSHEET

- What instructional objectives were met? How do I know?

- Were students actively engaged? How do I know?

- Did I alter my instructional plan? How and why?

- What formative assessment(s) did I use?

- What would I do differently the next time?

- What additional resources and/or support would enhance this activity?