Lesson Plan 3: Controllers

Title: Alpha, Bravo, Charlie

Aerospace Workforce Educator Program lessons are designed to help students build the foundational skills needed for aviation careers while gaining early awareness of the many professions that support our aviation system. Each lesson introduces core concepts—such as navigation, communication, safety, design, or problem-solving—and connects them directly to the real work of pilots, air traffic controllers, drone operators, maintenance technicians, airport specialists, and other aviation professionals. By making these connections visible and age-appropriate, educators can help students see how classroom learning links to real careers and inspires interest in fields they may not yet know exist.

Grade Level: Varies
Primary STEM Skill Focus Area: Problem Solving
NextGen Science Standard: 3-5-ETS1 Engineering Design

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1 Lesson Objectives

Students will be able to:

- Explain why air traffic control is important to the safe operation of the National Airspace System
- Identify the different types of air traffic controllers and explain how and where they work
- Explain how controllers use problem-solving skills to safely guide aircraft to their final destinations

2 Overview

This lesson introduces students to air traffic control (ATC) careers. The lesson includes content on how controllers in various facilities, e.g. Towers, Centers, and Terminal Radar Approach Control (TRACON) Facilities, ensure safe operation of aircraft in the National Airspace System.

The presenter, an Educator, will engage the students in a two-way discussion on the topics of this lesson. If applicable, the Educator will discuss which FAA facilities or airports in the local community employ various air traffic control equipment, controllers, or buildings.

3 Resources

This section includes resources for the Educator to review in preparation for delivering the lesson. Table 1 is a list of terms to know. Table 2 is a list of possible resources that can be shared with the students as part of the lesson. Educators should review the resources and links in advance of the lessons to ensure the content is consistent with school policies and security protocols before presenting them to students.

Table 1. Terms to Know

Term	Definition
Airport Traffic Control Tower (ATCT) or Tower	Towers provide the FAA's most visible service, thanks to their location high above the nation's runways. The controllers in Tower Cabs direct airplanes to runways, and from runways to taxiways to gates. Soon after takeoff, Air Traffic Controllers in a Tower "hand the plane off" to a different set of Controllers – working in a radar approach facility.
Terminal Radar Approach Control Facility (TRACON)	Air Traffic Controllers in the TRACON control planes after they have taken off and are several miles away from the Tower, or on their final approach to the airport. These Air Traffic Controllers are watching the airplane on a radar screen but cannot see the plane like the controllers in the Tower can. The TRACON guides plane until they are about 40 miles away from the airport, and then "hand off the" the communication with the plane to the Air Traffic Controllers at the Center for long distance travel.
Air Route Traffic Control Facility (ARTCC) or Center	Air Traffic Control Centers work with planes that fly across the country or over water, at high altitude. These planes are now flying high in the sky. The Air Traffic Controllers in the Centers take over from the TRACON controllers to guide the plane while it is traveling across the country. These Air Traffic Controllers are watching the plane on a radar screen in a building. They cannot see the planes the way the Tower controllers can.

Table 2. Potential Materials for Use During the Lesson

Title	Length	Source	Platform	Description
1. FAA101 (ATC process)	6:40	FAA	YouTube	Minutes 1:00 - 2:30 provide a description on each type of ATC controller and handoffs between them.
2. A Day in the Life of Air Traffic Over the United States	2:57	AirBoyd	YouTube	A great video that can be used when talking about the volume of flights in the US. Narrator explains hubs, why traffic levels increase and decrease, and military airspace. Minutes 1:42 – 2:57 demonstrate impacts of weather on flights, with ATC diverting planes.
3. Air Force ATC	2:32	U. S. Air Force & Space Force Recruiting	YouTube	AF ATC provides order in the skies
4. How ATC Works	4:19	FAA	YouTube	ATC procedures in and out of Southern California..

Title	Length	Source	Platform	Description
5. Air Traffic Control 101	1:29	FAA	YouTube	Learn how air traffic control works.
6. Meet Beth Vanaman: FAA IT Specialist	1:14	FAA	YouTube	Beth, an FAA IT Specialist, manages an air traffic control system.
7. Map for role play with aircraft traveling across the country	N/A	N/A	N/A	Ideally each map would show the progression of the airplane from gate to runway to airborne as it is passed from tower to TRACON to ATC center
8. Role Play Scripts	N/A	FAA	MyFaa.Gov	The script will help the students role play the progression of the airplane from gate to runway to airborne as it is passed from tower to TRACON to ATC center. Alternate scripts can provide examples of problem solving due to air traffic congestion and/or weather. available on MyFAA.gov
9. Phonetic Alphabet	N/A	FAA	FAA.gov	Using phonetic alphabet for aircraft identification activity "(page 19)"
10. NATCA Coloring Book	N/A	NATCA	Natca.org	14-page book on air traffic control facilities, with coloring activities for young children

4 Activate Prior Knowledge (3 minutes)

The questions below are suggested prompts that can be used to introduce the lesson. Educators should modify these questions to align with their audience, community, and personal experiences.

- Who has been a passenger in a car?
- What are some rules on the road that keep drivers safe?
  [Speed limits, street signs, rules, traffic lights]
- Who do we have to help enforce these rules?
  [Traffic police]
- Who has seen an airplane or a helicopter flying in the sky?
- Who has taken a trip in an airplane?
- Who directs airplanes on the ground / at an airport or in the sky?
- What happens when you have a trip planned in a car but there is bad weather? How can weather change your plans
  [Drive a different route, delay trip]
- Have you ever been to the drive-through of a restaurant and there is a line? What happens if

you pull up and there are other cars waiting in front of you?
[You have to wait, may decide to turn around, or you get in line]

5 Instructional Sections

The lesson sections listed below are talking points to help the presenter deliver a consistent message about air traffic controllers, some of their critical skills, as well as air traffic facilities.

Educators should modify these sections and the suggested timing to align with their audience, community, and personal experience.

The section also includes links back to some of the items listed in the Resources Section.

5.1 Introduction to Air Traffic and Rules of the "Sky" (5 minutes)

- The Federal Aviation Administration (FAA) oversees the flights in the United States every day
- During the busiest time of the day, there are over 5,000 aircraft in the sky at each given moment
- An Air Traffic Controller's job is to keep pilots and passengers safe as they travel (24 hours a day, 7 days a week)
- Air Traffic Controllers are constantly monitoring their airspace and giving directions to pilots
- Air Traffic Controllers tell planes when to takeoff, which route to travel, when to turn, when they can land, and which runway to use
- An Air Traffic Controller (ATC) solves a variety of complex problems every day at work
    - Busy airspace means the ATC is working to maintain distances between all of the aircraft while making sure everyone can take off, land, and continue flying to their destination
    - Weather can cause problems where the ATCs need to work to reroute aircraft
    - Emergencies are rare, but ATCs work calmly to assist the pilot to reroute and land
- Solving problems means an ATC will have to think very quickly, often making split-second decisions, which they will then have to communicate to pilots
- Airplanes have rules in the sky, just like cars have rules when driving on a road
- One of the rules is that there needs to be a "bubble" around each plane as it travels
- This helps keep planes a safe distance apart
- The "bubble" is a pretty big space, though – it is generally about 1,000 feet above one another and three to five miles between each plane
- This is the same idea as when we drive in a car and leave a space between our car and the car in front of us on the road
- Air traffic controllers are always watching to make sure there is a safe distance between each aircraft
- Air Traffic Controllers also pay attention to the weather, so they can inform the pilots if they are expecting bad weather

- Sometimes, controllers even ask planes to change their route because of bad weather
- If the weather is bad near the airport, the controllers will not allow the planes to take off
- And if there are planes coming that are supposed to land, they can be asked to hold (or wait) in the sky or go to another airport to land
- When the planes are waiting in the air, they enter a "holding pattern."
- These holding patterns are like a racetrack in the sky; the planes circle around the airport or in a different area, until the controllers tell the pilot that it is safe to land

5.2 Types of Air Traffic Controllers (15 minutes)

- Each type of controller has a specific job to do to direct airplane traffic
- Let's watch a short video about Air Traffic Control: FAA101 ATC video from 1:00 – 2:30
- What types of Air Traffic Control facilities did the video mention?
  [Tower, Terminal Radar Approach Control Facility (TRACON), and Center]
- Each of these facilities is responsible for a specific part of the airplane's travel

5.2.1 Controllers working in the Towers

- The Air Traffic Controllers in the tower work in the towers you see at an airport
- They talk to the pilots while they are still on the ground at the airport
- They watch the planes out of the Tower cabin (or cab) and tell them how to get from the gate to the runway
- They also tell the planes which runway to use and watch to make sure the planes do not get too close to each other
- These controllers are talking to planes that are just about to land, or just took off from the airport
- Once a plane is about 5 miles away from the airport, the controllers instruct the pilot to call the Terminal Radar Approach Control Facility, or TRACON, and give them the radio channel to use
- The controllers can see the planes from the Tower Cab and make sure the runway is clear and no other planes are in the way
- Tower controllers permit the planes to take off and might also ask the planes to wait on the ground
- These controllers solve problems on the ground, guiding aircraft to taxi to takeoff and after landing, while making sure everyone is a safe distance apart

5.2.2 Controllers working in the TRACON

- The TRACON Air Traffic Controllers work in a radar room, so while they can see the planes on the radar screen, they are not looking out the window at them
- Many TRACON facilities are not even located at the airport; they can be miles away
- Others are located at the bottom of an airport Tower, that type of facility is called an "Up-Down"

- TRACON controllers work with the planes soon after takeoff
- Remember, the planes are only 5 miles away when the Tower hands off the plane
- The TRACON controllers communicate with the planes until they are about 20-40 miles away from the airport and about 15,000 feet in the air
- The big jets that you see near big airports take off at about 150 miles per hour - WAY faster than a car
- And at that speed, they would travel 40 miles with the TRACON controller in charge in less than 10-15 minutes
- Once the plane reaches that point, the TRACON controller will let the plane know to contact the Air Traffic Controllers in the Air Route Traffic Control Center (or "center" for short)
- TRACON controllers solve problems during takeoffs and landings and blend departures with arrivals. They make sure each aircraft has enough space and give directions to keep everyone moving safely after takeoff and just before landing

5.2.3 Controllers working in the Centers

- The United States has 22 Air Traffic Control centers, which control the planes as they travel high in the sky
- Each center controls a huge airspace so they can talk to the planes longer than the TRACONs or Towers
- The Center controllers are also watching the planes on a radar screen
- Controllers in the center are assigned to work in a specific area of the center and know everything about that piece of the sky
- When an aircraft enters their area, they watch on the radar and give information to the pilots
- They may tell them about the weather, ask them to turn, or even to climb higher or descend
- As the plane is getting ready to land, the Center controllers will hand the plane back to the TRACON
- Controllers in the center solve problems with weather, rerouting planes when necessary. They also make sure everyone in their airspace who may be landing soon is on the correct path to their final destination

5.3 Their Own Language (5 minutes)

- Pilots and Controllers communicate using specific language (see ATC Lingo below)
    - Prevents misunderstandings
    - English is official language of ATCs and pilots globally
    - Keeps communication short and to the point so no one is on the radio for too long
    - Commands are repeated to confirm they are understood
    - Air traffic controllers and pilots use this specific vocabulary to ensure safety
    - Pilots repeat the commands of the Air Traffic Controller back on the radio to show they have understood.

- Pilots and Air Traffic Controllers repeat the plane's callsign with every instruction to make sure the correct pilot has the correct information

– Play a clip of ATC/pilot communication

– Display the Phonetic Alphabet and discuss how controllers use it to keep everyone safe

Table 3. Sample Air Traffic Control Phraseology

Phrase	Meaning
Cleared for takeoff	Authorization for an aircraft to depart
Cleared to land	Authorization for an aircraft to land, based on traffic and physical airport conditions
Go around	Instructions for a pilot to abandon the approach to landing
Line up and wait	Inform the pilot to taxi onto the departure runway to line up and wait
Say again	Request to repeat the last transmission/communication with the pilot
Stand by	Request for the controller or pilot to pause for a few seconds

5.4 Activity (15 minutes)

The table below includes sample activities that can be used as part of the lesson. Please select one or two, depending on the time available:

Table 4. Sample Activities

Activity	Objectives	Educator Actions	Student Actions	Closing
Phonetic Alphabet	Identify how Air Traffic Controllers communicate to avoid problems	• Share the phonetic alphabet chart • Have students make their own identification number / call sign.	• Create an aircraft identification (ID) number • Draw an aircraft and add the ID number	• How are call signs important for safety and clear communication? • If the controllers and pilots did not use call signs, what might happen?
Role Play	Demonstrate how Air Traffic Controllers solve problems	• Have students volunteer to role-play pilot, tower, TRACON, and center. • Help walk the class through the procedures from gate to gate.	Students will read the script provided. The students will observe the language of pilots and ATC, as well as the ATC's ability to problem solve when there is traffic on the runways or weather affecting travel.	Notice how the pilots repeat what the ATC says to them. Why do you think they do this? Why do they repeat their call sign?

6 What Did You Learn?

For closing and wrap-up, Educators can ask the students the following questions:

- How many different types of ATCs are there?
- What are some of the instructions an ATC gives to a pilot?
- Why do we need a “bubble” around an airplane?
- What are some ways ATCs use problem-solving to keep a pilot (and passengers) safe?
- What is a holding pattern, and how is it like a racetrack?
- Why do pilots and air traffic controllers need to use specific language to speak to each other?

Suggested Visual/Game:
Show 2-3 summary slides, local ATC staff in action, or use a jeopardy style game

7 Extension Activities

- Visit an airport tower, TRACON, or ATC center
- Interview an ATC about their job
- Work with the NATCA Coloring Book

8 Supplies

- Access to the Internet to view and share videos and slides on screen
- Crayons
- Spark sheet (PDF) for students