Gate to Gate

A multimedia experience with career guidance print materials for high school and community college students interested in air traffic control.

Produced by
NASA Ames Research Center
and
the Federal Aviation Administration

Susanne Ashby
Curriculum Specialist

Amberlee Chaussee
Design & Layout

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Introduction

The ***FAA Career Guidance Package*** has been developed by the National Aeronautics and Space Administration and the Federal Aviation Administration for the purpose of introducing students to the range of opportunities available in the world of air traffic control. These materials are to be used in conjunction with the informational CD-ROM ***Gate to Gate***. The activities are designed to enhance the student's experience with the CD-ROM while broadening their knowledge of the air traffic control system and the work of air traffic controllers. The ***FAA Career Guidance Package*** is divided into four sections. Following the *Introduction*, there is a *Student Activity Packet*, a *Multimedia Student Logbook,* and *Additional Resources*.

These materials contain activities that the students can use to accomplish the following:

- broaden their knowledge about air traffic control
- familiarize themselves with the skills and abilities of an air traffic controller
- engage in an activity similar to the work of an air traffic controller
- perform follow-up research using the given additional resources

1. The *Student Activity Packet* is divided into the following three sections:

- **Cleared for Takeoff**
  A brief introduction to the world of air traffic control.

- **Student Informational Readings**
  These readings serve as a text-based elaboration of the information available on the CD-ROM. These readings cover in greater depth the air traffic control system and the differentiation between the types of controllers. Their daily work requirements as well as the training and education involved in this occupation are also covered.

- **What Does it Take to be an Air Traffic Controller?**
  This section is comprised of a set of exercises that assist the student in gauging if he/she has the appropriate set of skills and abilities necessary to join the ranks of air traffic control. As the student progresses through each exercise, he/she gains an understanding of the type of tasks an air traffic controller is required to perform daily, as well as an appreciation for the competencies needed to perform this type of work. The student should be able to identify his/her own personal skill set and see how it relates to the skills and abilities needed by an air traffic controller. These exercises are not diagnostic tests and their results, therefore, are not to be construed as definitive descriptors for career potential as an air traffic controller.

2. The *Multimedia Student Logbook* is to be utilized alongside the CD-ROM's activities to enhance the student's interactions and to engage the student in a more meaningful way. As the student progresses through each segment of the CD-ROM ***Gate to Gate***, these guidesheets will serve to relate the on-screen activities to the work of an air traffic controller.

3. *Additional Resources* is the final section of these materials. It contains a list of resources that the student can use to learn more about aeronautics and aviation occupations, or to perform further research on the sophisticated tools used in air traffic control. This resource section is divided into three listings of web sites, publications, and associations and agencies affiliated with air traffic control or aviation. Each entry includes a brief description.

We hope you find these materials, the ***FAA Career Guidance Package*** and the CD-ROM ***Gate to Gate***, helpful in introducing your students to the world of air traffic control occupations.

Gate to Gate

Student Activity Packet

Ready for Takeoff!

If you are considering a career in air traffic control, then this packet of information and the accompanying CD-ROM ***Gate to Gate*** is designed just for you!

The Student Activity Packet contains two sections: "Student Informational Readings" and "What Does it Take to be an Air Traffic Controller?" In the student readings you will be introduced to the air traffic control system and the various types of work performed by air traffic controllers. Using the guidesheets from the section "What Does it Take to be an Air Traffic Controller?" you will become increasingly aware of the skills, abilities and aptitude needed for air traffic control. You do not have to complete every single page or reading in this packet, but if you do, you will develop a very clear picture of what kind of skills and abilities are involved in air traffic control occupations.

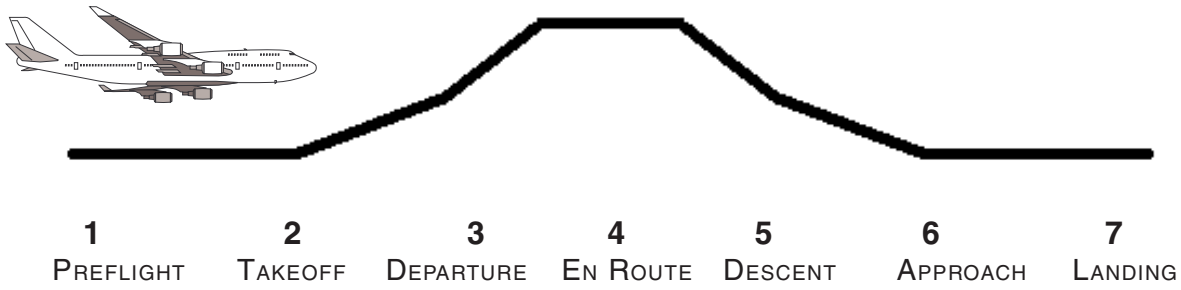
We hope this unique experience will give you greater insight into and appreciation for the work of air traffic controllers.

Gate to Gate

Student Activity Packet

Student Informational Readings

Commercial Flight Profile in Brief



1. Preflight

The weather information has been received by the pilot and a flight plan has been filed. Prior to takeoff, the pilot performs the flight check routine, pushes back the aircraft from the terminal's gate, and taxis out to the designated takeoff runway.

2. Takeoff

The pilot receives permission from the tower to take off. The aircraft powers up and starts the takeoff roll.

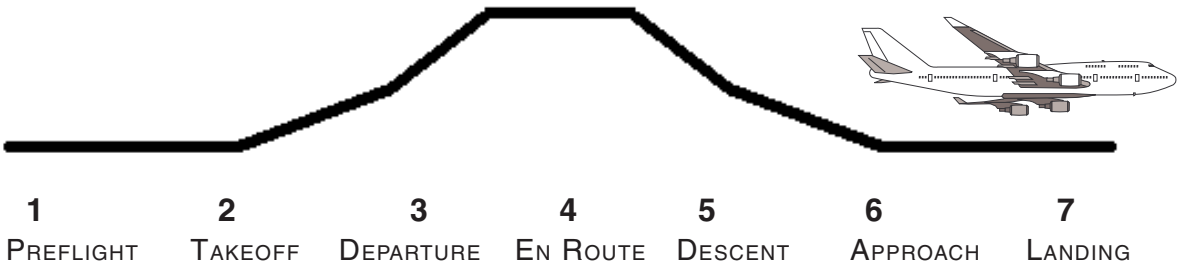
3. Departure

Upon lift off, the pilot changes radio frequency to receive new flight instructions. The pilot is instructed to follow a pre-determined, preferred routing that will take the aircraft up and away from the departure airport and on its route. The pilot is then issued a further altitude and routing clearance. The controller monitors the target and track of the aircraft and performs an electronic transfer of the aircraft to the next controller prior to the aircraft entering the receiving controller's airspace.

4. En Route

The pilot receives instructions as to what altitude and heading to maintain, as well as to which radio frequency to tune. This portion of the flight can be as short as a few as minutes or as long as many hours. As the aircraft nears its destination airport, the pilot changes radio frequency and receives instructions for altering altitude and/or heading for the descent.

Commercial Flight Profile in Brief (continued)



5. Descent

After receiving instructions for changes in heading and/or altitude, the aircraft descends and maneuvers to the airport.

6. Approach

The pilot has received an approach clearance to the destination airport and has been placed in line with other aircraft preparing to land at the same airport. The pilot flies a specified procedure in order to get in line for the designated landing runway.

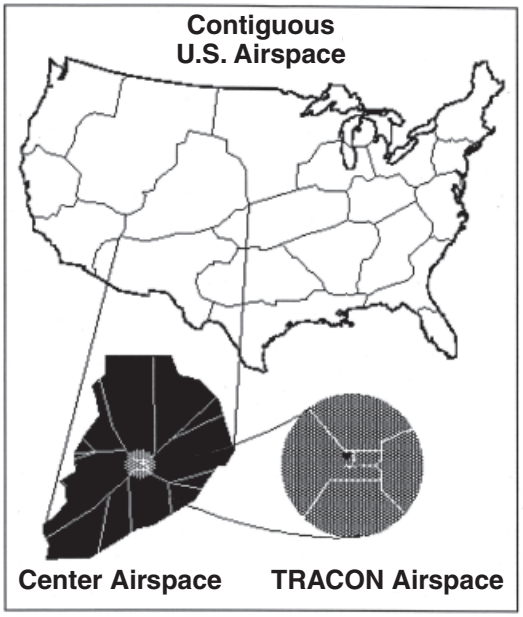
7. Landing

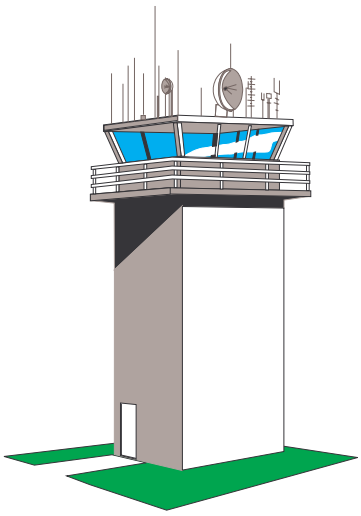
The pilot has been cleared to land and lands on the designated runway. The flight is then routed across the taxiways to its destination gate at the terminal.

The Air Traffic Control System

As an agency of the U.S. Department of Transportation, the Federal Aviation Administration (FAA) runs the Air Traffic Control (ATC) system. The system was developed primarily to maintain safe separation of aircraft throughout the U.S. and to keep air traffic flowing as orderly and efficiently as possible. The system of air traffic control that has been developed includes Towers, Centers, TRACONs, the Air Traffic Control System Command Center as well as Flight Service Stations.

The airspace over the United States is divided into 21 large areas called Centers (20 in the contiguous United States plus Alaska). Within each Center are a number of TRACONs. TRACON is an acronym for **T**erminal **R**adar **A**pproach **CON**trol. Within each TRACON are a number of airport control towers (referred to as satellite airports). Overseeing all of this activity in the Centers and TRACONs is the Air Traffic Control System Command Center located in Herndon, Virginia. Here "Central Flow Control" looks for situations that will create bottlenecks or other problems in the efficient flow of air traffic, and responds with a management plan to keep the air traffic flowing smoothly.



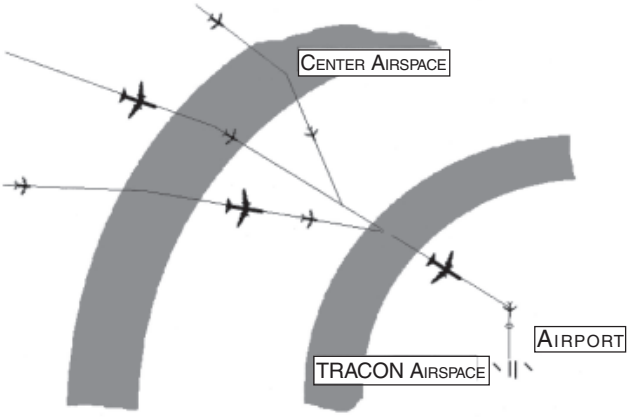


Tower

Each major airport maintains a control tower which houses air traffic controllers who monitor all aircraft taxiing, taking off and landing at that airport. They own the airspace up to 3,000 feet above the airport and a radius of 5 miles around the airport. These controllers have three different positions through which each rotate during their shift assignment: clearance delivery, ground control and local control.

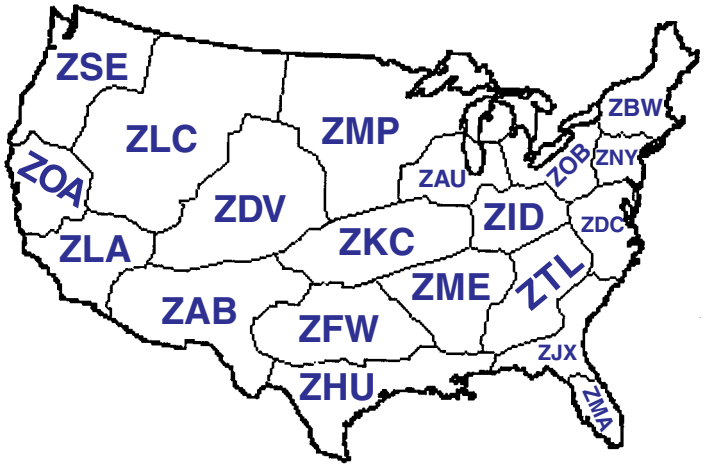
TRACON

When an aircraft is in the departure, descent and approach phases of a flight, the aircraft is being monitored by controllers in the TRACON. One TRACON can handle the air traffic for several different airports in its vicinity. The airspace of a TRACON has various dimensions. Dallas-Ft. Worth TRACON, for example, monitors the airspace from 17,000 feet and below, and approximately a 40 mile radius from the Dallas-Ft. Worth airport.



Center

Once an aircraft is in the en route phase of its flight, it is monitored by the region's Air Route Traffic Control Center. As it passes through each Center's airspace, it is handed off from Center to Center until it reaches its destination airport and prepares for descent. At this point it is electronically handed off to the TRACON and then handed off to the destination airport's control tower.



Flight Service Station

The FAA also maintains Flight Service Stations that serve as information centers for private pilots flying in and out of airports in small cities and rural areas. The Flight Service Station provides the pilots with such information as weather reports, route information, terrain information and flight plan assistance. Additionally, these stations offer assistance to pilots during emergency situations, as well as initiating and coordinating search and rescue efforts for missing or overdue aircraft.

The Many Roles of an Air Traffic Controller

Air traffic controllers are employed by the Federal Aviation Administration. Each air traffic control candidate must undergo an initial screening process before moving on to the FAA's training center in Oklahoma City, Oklahoma (Mike Monroney Aeronautical Institute). Upon successful completion of the training program in Oklahoma City, each candidate is assigned to an actual air traffic control facility where they continue through the training program which includes academics in a classroom environment and simulated ATC problems in a lab environment. Before being certified, all air traffic controllers must successfully complete each stage of training. During the training process emphasis is placed on learning a specific geographical area, communication, procedures, equipment capabilities and teamwork, as well as the varying techniques of getting the job done safely and efficiently. This training program ranges from one to three years in duration depending on the air traffic facility.

After a controller is certified FPL (Full Performance Level), and has generally been at the facility for at least one year, there are other job areas the controller may want to pursue:

- Mike Monroney Aeronautical Center (Oklahoma City, OK)
- FAA Headquarters (Washington, D.C.)
- Air Traffic Control System Command Center (ATCSCC) (Herndon, VA)
- Regional Headquarters
- Technical Center (Atlantic City, NJ)

These are all considered staff jobs and deal with a wide range of subjects.

Not all air traffic controllers work at an airport control tower. In addition to the FAA training center, there are four types of FAA facilities at which a controller can be employed:

- Air Traffic Control Tower (ATCT)
- **T**erminal **R**adar **A**pproach **CON**trol (TRACON)
- Air Route Traffic Control Center (ARTCC or Center)
- Flight Service Station (FSS)

Air Traffic Control Tower

- **Clearance Delivery**
  Checks flight plan and gives clearance to pilot for flight plan information.

- **Ground Controller**
  Monitors all ground movement around the airport. The ground controller issues push back from the gate and taxi instructions to get the aircraft to the runway.

- **Local Controller**
  Gives clearance for takeoff and instructs pilot as to next radio frequency for contact with the departure controller. Also, gives clearance for landing and initial instructions for taxiway routing, then instructs the pilot to contact ground control.

TRACON (Terminal Radar Approach CONtrol)

- **Approach Controller**
  Directs several lines of descending aircraft into one smooth flowing line of aircraft as their courses take them closer to the destination airport.

- **Feeder Controller**
  Takes the hand-off from the Center and directs the arrival aircraft from about 40 miles out into the destination airport.

- **Departure Controller**
  Routes air traffic immediately upon takeoff via a preferential departure route (PDR) leading away from the departure airport as the aircraft ascends to the en route phase of flight.

Center

- **Radar Controller**
  The radar controller is in charge of the sector. This controller maintains positive separation among all aircraft under his/her control. Separation standards from a Center are defined as 5 miles laterally or longitudinally for aircraft flying at the same altitude, or 1,000 feet vertical separation below 29,000 feet and 2,000 feet vertical separation above 29,000 feet. The radar controller is responsible for all air-to-ground communications. Coordination with other sectors and facilities is a duty shared by both the radar controller and the radar associate controller.

- **Radar Associate Controller**
  The radar associate controller assists the radar controller and receives flight plan information on aircraft anywhere from 5 to 30 minutes in advance of aircraft entering the sector. The associate controller works with the radar controller to plan separation of aircraft and to coordinate with other sectors and facilities.

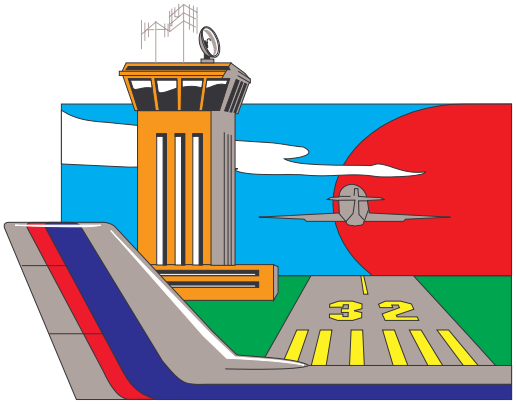
- **Radar Hand-off**
  The radar hand-off controller assists the radar team when air traffic becomes very heavy. This controller serves as another set of eyes to maintain separation of aircraft and coordinate with other controllers and facilities as necessary. This extra help also serves to maintain a smooth and efficient flow of air traffic.

Flight Service Station

- **Flight Service Specialists**
  The variety of duties for the Flight Service Specialist involve such tasks as performing pilot briefings, coordinating search and rescue for lost pilots, performing weather briefings, and filing IFR and VFR flight plans as well as military flight plans.

This variety of air traffic control operations, personnel and locations all coordinate to ensure a smooth and efficient flow of air traffic across the United States.

How It All Works Together



Every minute hundreds of commercial aircraft push back from their departure gates and begin flights that follow a common flight profile. The flight begins in preflight when weather information is obtained and a flight plan is filed. After the departure clearance is given from the tower, the aircraft pushes back from the gate, and receives instructions from the ground controller in the airport's control tower on the appropriate taxiways to take towards the takeoff runway. "Cleared for takeoff," is issued by the Local (Tower) Controller. Shortly after takeoff, the pilot is instructed to change radio frequency and contact Departure (TRACON) Control. The aircraft is now in the departure phase of flight. During this phase the aircraft is routed away from the airport via an assigned heading with a climb clearance to a new altitude.

After departure, the aircraft is handed off to a Center controller. The aircraft is now moving into the en route phase of flight. The Center controller monitors the flight and gives instructions to the pilot as the aircraft passes through the Center's airspace from sector to sector. This phase can last from a few minutes up to many hours depending on the distance between the departure and the destination airports. Once the aircraft is within approximately 150 miles of its destination airport, it begins its descent phase, when it moves from its cruising altitude to a lower altitude. Approximately 50 miles from the airport the aircraft is handed off to the TRACON controller where the descent continues during the approach phase of flight. The Approach Controller in the TRACON is blending several streams of descending aircraft into one smooth flowing stream of aircraft to line up for a particular runway.

The flight is then handed off from the controller in the TRACON to the Local Controller who is stationed at the destination airport's control tower. The Local Controller issues "Cleared to land". The Ground Controller instructs the aircraft on which taxiways to use. From the time the aircraft lands on the runway until it pulls up to the gate, the airport's control tower is in control of the aircraft. It is this entire network of controllers and facilities that monitor and control the traffic in the airspace above the United States.

Gate to Gate

Student Activity Packet

What Does it Take to be an Air Traffic Controller?

Characteristic Checklist

Directions: Place a check in the blank next to each description which best describes you, what you are able to do, what you enjoy doing, or what kind of work you prefer. Then follow the directions on the last page to score your responses.

_____ 1. Usually I can make decisions quickly when it is necessary.

_____ 2. I have a hard time concentrating in a busy room.

_____ 3. I can easily visualize objects three dimensionally.

_____ 4. Maps are difficult to read.

_____ 5. I can easily focus on what I'm doing regardless of how busy the room is.

_____ 6. I usually forget what someone has told me verbally.

_____ 7. I like to experience movement when I work.

_____ 8. I remember things with greater accuracy and for longer periods of time if I hear them.

_____ 9. I consistently remember things that I've heard.

_____ 10. I cannot visualize three dimensionally the terrain that a map is depicting.

_____ 11. I remember things with greater accuracy and for longer periods of time if I can read them.

_____ 12. I can sit still for hours and accomplish my work.

_____ 13. I can look at a flat map and visualize what the terrain looks like.

_____ 14. My short term memory fails me often.

_____ 15. Map reading is easy and enjoyable.

_____ 16. I can only picture landforms and buildings like a flat map.

_____ 17. I am usually hesitant at making decisions.

_____ 18. I have a good short term memory.

Characteristic Checklist (continued)

_____ 19. I would prefer working non-traditional work hours (not 8:00 a.m. – 5:00 p.m.)

_____ 20. I find it too difficult to focus on more than one task at a time.

_____ 21. I rarely panic in stressful situations.

_____ 22. I would not mind a job that required a lot of talking.

_____ 23. I would prefer working traditional work hours (8:00 a.m. – 5:00 p.m.).

_____ 24. I enjoy conversing with people.

_____ 25. I would not want a job that requires a lot of writing.

_____ 26. I prefer working at a leisurely pace.

_____ 27. I enjoy work that challenges me.

_____ 28. I can easily juggle more than one task at a time and still keep track of each one.

_____ 29. I prefer not to engage in conversation with people.

_____ 30. I am an easygoing person who is slow to anger.

Characteristic Checklist (continued)

Directions: Complete the score sheet below by scoring 1 point if you checked a statement and 0 points if you did not check this statement. Add up your points for a total score and check your total with the key to find out if you have some of the characteristics necessary to be a good air traffic controller.

1. _____	7. _____	13. _____	19. _____	25. _____
2. [redacted]	8. _____	14. [redacted]	20. [redacted]	26. [redacted]
3. _____	9. _____	15. _____	21. _____	27. _____
4. [redacted]	10. [redacted]	16. [redacted]	22. [redacted]	28. _____
5. _____	11. _____	17. [redacted]	23. _____	29. [redacted]
6. [redacted]	12. _____	18. _____	24. _____	30. _____

Total _____ + _____ + _____ + _____ + _____ = _____

If your score is between:

16 - 19 You might want to look into an air traffic control career.

12 – 15 You seem to be a good candidate for air traffic control.

0 – 11 You might reconsider doing this type of work.

Mapping From Memory

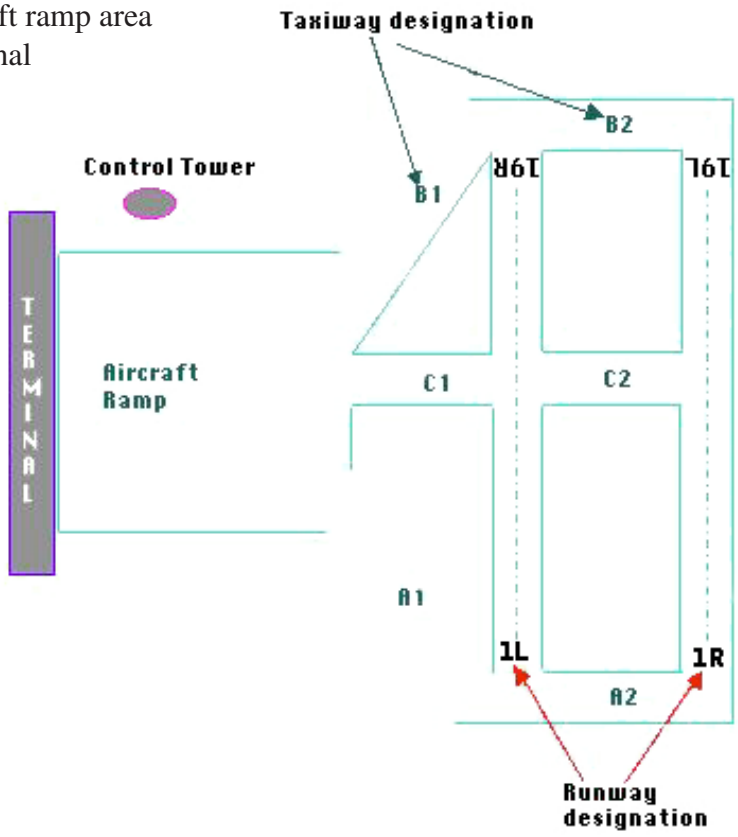
Directions: Air Traffic Controllers must have an excellent memory and be able to picture maps and drawings three dimensionally. Before one can begin air traffic control training, one must be able to memorize and draw from memory maps displaying air traffic control routes, aeronautical charts and airport layout maps. The map below is an airport layout map. A typical airport will have the following components:

- One or more runways
- Taxiways that aircraft use to get to the runways
- Ramp area for aircraft parking
- Terminal building where passengers and luggage move in and out
- Air Traffic Control Tower (ATCT)

Study the airport layout map carefully for two full minutes. Note the placement of each of the 5 main components and note the numeric designations of each runway and taxiway.

Using the next page, take 5 minutes to complete the outline of the runways and taxiways. Include the following components on your map:

- Mark each runway with its proper numeric designation
- Mark each taxiway with its proper numeric designation
- Label the control tower
- Label the aircraft ramp area
- Label the terminal

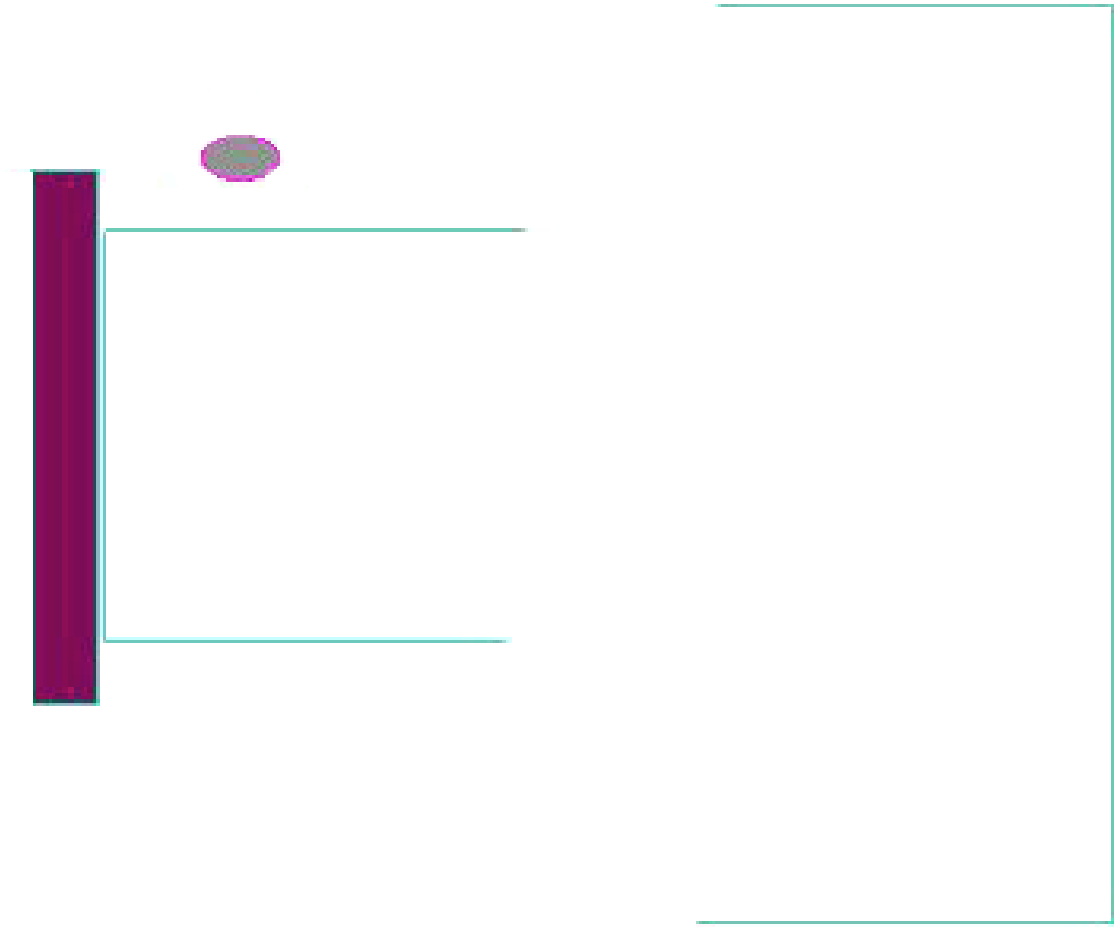


Mapping From Memory (continued)

Directions: After studying the airport layout map from the previous page, take 5 minutes to complete the outline of the runways and taxiways. Include the following components on your map:

- Mark each runway with its proper numeric designation
- Mark each taxiway with its proper numeric designation
- Label the control tower
- Label the aircraft ramp area
- Label the terminal

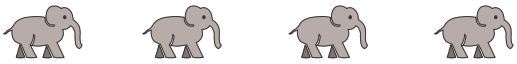
When you are finished, check your drawing with the map on the next page and assess your recall score with the score box.

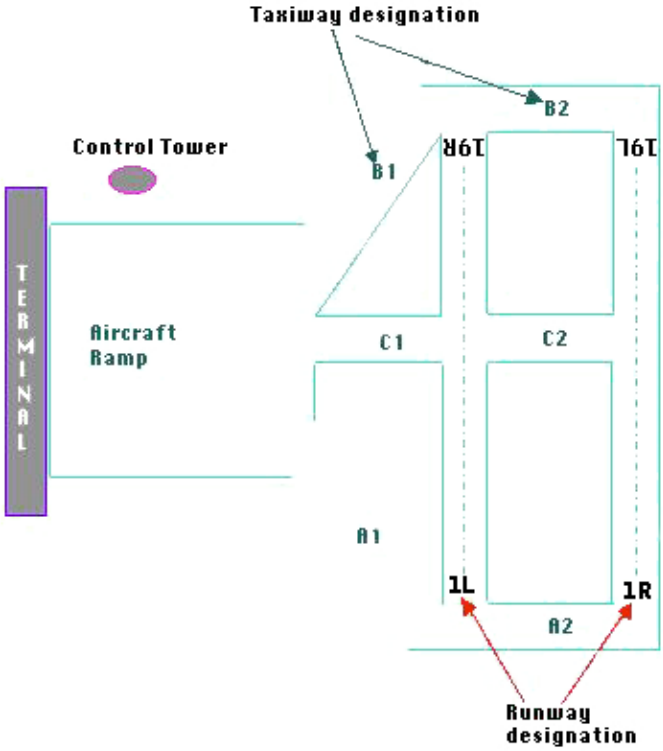


Mapping From Memory (continued)

Scoring: All in all, there are 4 runways with the designations 1L, 1R, 19L, 19R and 6 taxiways with the designations A1, A2, B1, B2, C1, C2. Score one point for each runway you drew and one point for each runway you correctly marked. That would be 8 points altogether. Score one point for each taxiway you drew and one point for each taxiway you marked correctly. That would be 12 points in all for taxiways. Score 1 point each for correctly identifying the aircraft ramp, the control tower and the terminal. That would be 3 points for those areas. Your highest total score could be 23 if you correctly marked and labeled everything! Check your recall score in the box below.

Recall Score Box

23	**You have a memory like a herd of elephants!**
20 - 22	
17 - 19	
14 - 16	
13 and below	



I Hear It… I Remember It...I Can Say It

Directions: Air Traffic Controllers must retain much information that they hear. Have a partner read aloud the list below, saying each term twice slowly every five seconds until the entire list is read. Then, on a blank sheet of paper record each item from memory. Check your memory by comparing your list to the list below. Score one point for each item remembered and check your results with the score card below.

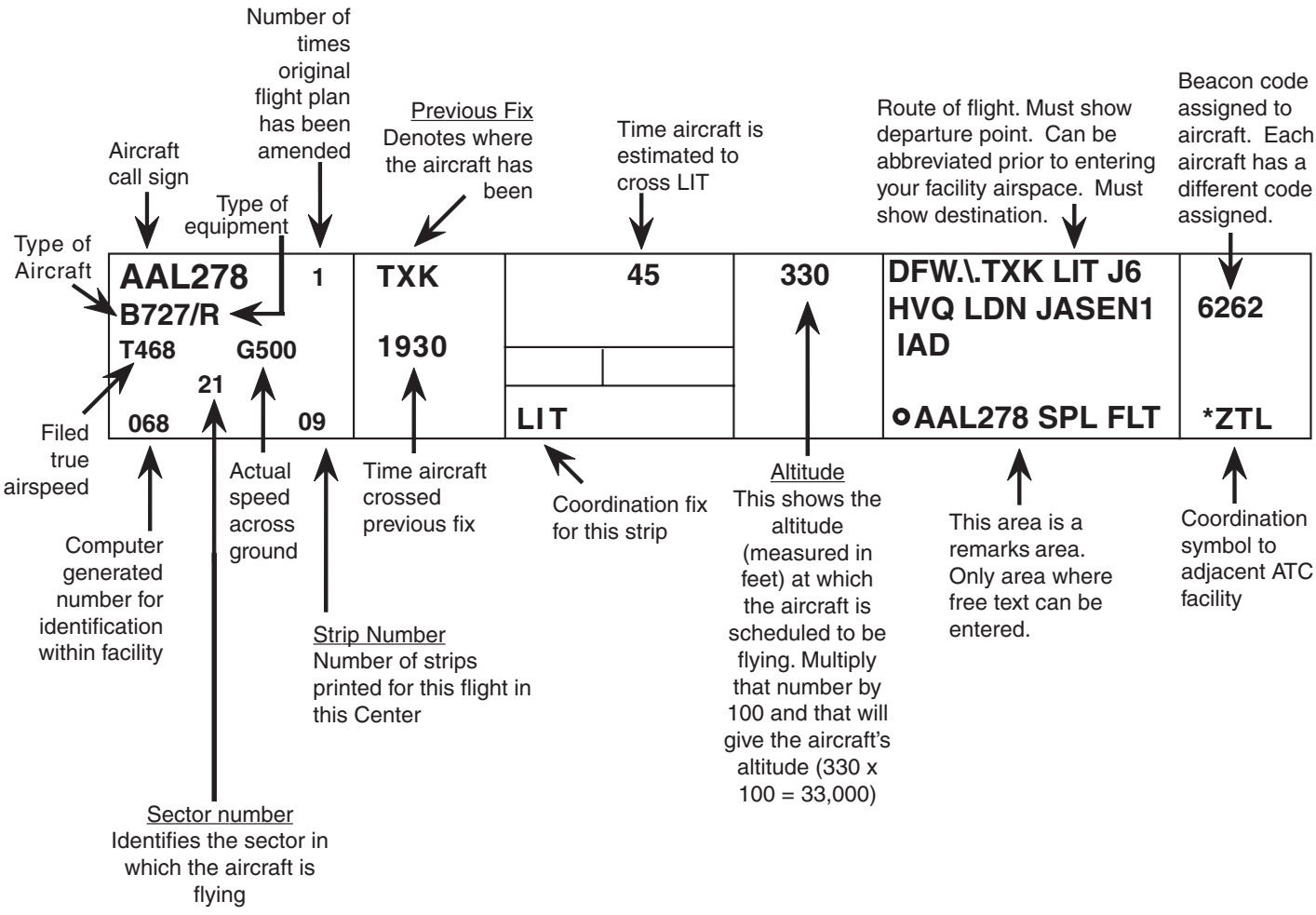
1. one-five-three
2. Roger
3. I-L-S
4. cleared for takeoff
5. flight 1224
6. maintain
7. vector
8. flight level
9. runway three-five
10. taxi

SCORECARD

10	Your auditory neurons are <u>all</u> firing.
8 - 9	Your ear-brain connection is excellent.
0 - 7	There must have been static on your auditory signal line.

Reading a Strip

Directions: Before a flight, flying under Instrument Flight Rules (IFR), takes off the pilot must file a flight plan. This plan contains important information that is used to track the aircraft during its flight. The information given is sent to the Host (or main) computer in the Center. The Host computer consolidates the information onto a "strip" (which is exactly that: a rectangular strip of paper!). Carefully read over the detailed strip below.



Reading a Strip (continued)

Directions: Look over the strip below and answer the questions.

DAL542 1 MD80/A T468 G555 16 486 09	MOL 1827	33 18 CSN	330	ATL MOL CSN J48 EMI PHL	2675 ZNY

1. Give the aircraft's call sign.

2. What beacon code is assigned to this aircraft?

3. From which sector is this strip?

4. What is this aircraft's filed true airspeed?

5. At what altitude will this aircraft be flying?

6. For what type of aircraft has this strip been prepared?

7. What is the coordination symbol for the adjacent air traffic control facility?

Reading a Strip (key)

Directions: Look over the strip below and answer the questions.

DAL542 1 MD80/A T468 G555 16 486 09	MOL 1827	33 18 CSN	330	ATL MOL CSN J48 EMI PHL	2675 ZNY

1. Give the aircraft's call sign.

   Delta Airlines flight 542

2. What beacon code is assigned to this aircraft?

   2675

3. From which sector is this strip?

   16

4. What is this aircraft's filed true airspeed?

   468 knots (T468)

5. At what altitude will this aircraft be flying?

   33,000 feet (330)

6. For what type of aircraft has this strip been prepared?

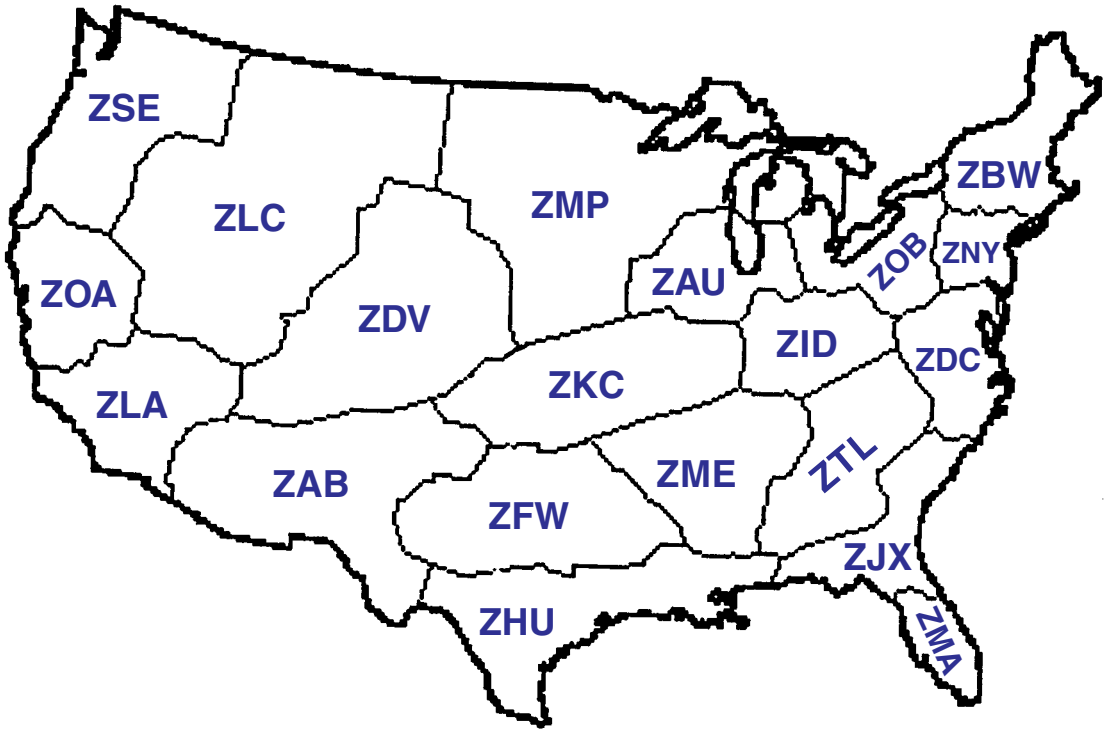
   MD80/A

7. What is the coordination symbol for the adjacent air traffic control facility?

   ZNY (which is New York Center)

Know Your Airspace

Directions: All air traffic controllers not only know in great detail the airways and geography of the airspace in which they serve, but they also know the locations and designations of the entire airspace of the contiguous United States. The map below shows the airspace designations for the 48 contiguous United States. The designations are identified in the list following the map. Study this map carefully for five minutes. Then, on the next page, label each airspace with its appropriate 3-letter identifier.



ZSE	=	Seattle	ZOB	=	Cleveland
ZOA	=	Oakland	ZID	=	Indianapolis
ZLA	=	Los Angeles	ZTL	=	Atlanta
ZLC	=	Salt Lake City	ZJX	=	Jacksonville
ZAB	=	Albuquerque	ZMA	=	Miami
ZMP	=	Minneapolis	ZDC	=	Washington
ZKC	=	Kansas City	ZNY	=	New York
ZFW	=	Ft. Worth	ZBW	=	Boston
ZHU	=	Houston	ZDV	=	Denver
ZAU	=	Chicago	ZME	=	Memphis

Know Your Airspace (continued)

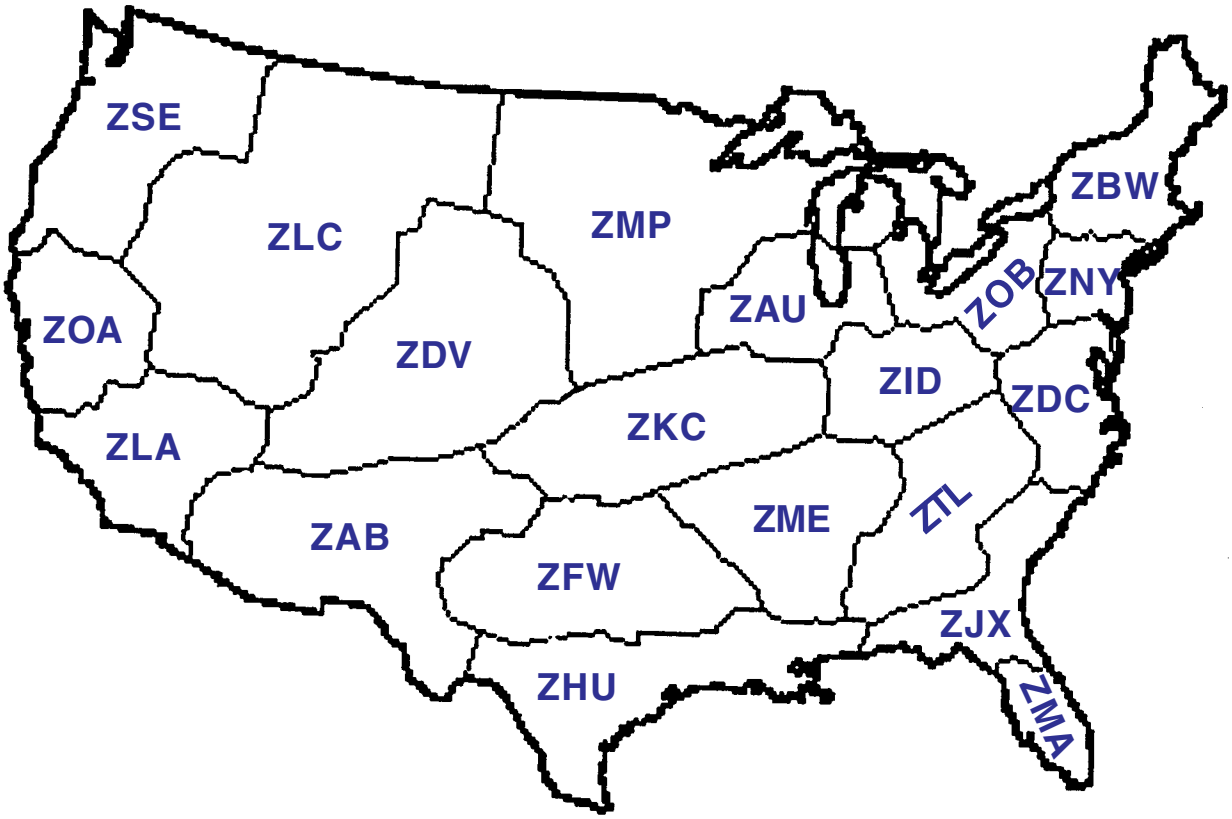
Directions: Using the designations listed below, place the correct airspace 3-letter identifier in its appropriate airspace on the map.

ZSE	**ZOB**	**ZAB**	**ZMA**	**ZBW**
ZMP	**ZDC**	**ZKC**	**ZNY**	**ZDV**
ZHU	**ZFW**	**ZME**	**ZAU**	**ZOA**
ZID	**ZLA**	**ZTL**	**ZLC**	**ZJX**

Know Your Airspace - Key

Directions: Using the designations listed below, place the correct airspace 3-letter identifier in its appropriate airspace on the map.

ZSE	ZOB	ZAB	ZMA	ZBW
ZMP	ZDC	ZKC	ZNY	ZDV
ZHU	ZFW	ZME	ZAU	ZOA
ZID	ZLA	ZTL	ZLC	ZJX



ATC DICTIONARY

Directions: It is true that air traffic controllers communicate using a special language. Below you will find a list of "ATC terms" that are used in communication between controller and pilot. After looking over these terms try a hand at "translating" the pilot to air traffic controller interactions on the next page. (If you're curious about the ICAO phonetics, check out page 32.)

AIRCRAFT IDENTIFICATION: Air carrier and other civil aircraft having FAA authorized call signs. State the call sign followed by the flight number together as one phrase.

Example: "American fifty two"
"United one zero one"
"Universal Air eleven twenty four"
"November two eight Mike"

APPROACH CLEARANCE: Authorization by ATC for a pilot to conduct an instrument approach to an airport.

AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS): The continuous broadcast of recorded non-control information in selected terminal areas. Its purpose is to improve controller effectiveness and to relieve frequency congestion by automating the repetitive transmission of essential, but routine information. Each broadcast will be given a phonetic alphabet designation; e.g. "ALPHA", "BRAVO", "CHARLIE". The ATIS broadcast will include, for example, some of the following: wind speed and direction, the airport's active runways, current air temperature, dew point, cloud conditions, altimeter reading, and other significant runway information. ATIS broadcasts are updated at least once per hour and given the next phonetic alphabet designation.

CHANGING FREQUENCIES: The controller instructs the pilot to change to a new frequency on the aircraft radio so that the pilot will communicate with another controller.

CLEARED (*specific type of*) APPROACH: ATC authorization for an aircraft to execute a specific instrument approach procedure to an airport.

CLEARED FOR TAKEOFF: ATC authorization for an aircraft to depart. It is initiated based on known traffic and known physical airport conditions.

COURSE: The intended direction of flight in the horizontal plane, measured in degrees from north.

FINAL APPROACH: That part of an approach procedure which begins at the specified final approach fix or point.

ATC DICTIONARY (continued)

FINAL APPROACH COURSE: A bearing, radial, track of an instrument approach leading to a runway or an extended runway center line all, without regard to distance.

FLIGHT LEVEL (FL): A level of constant atmospheric pressure related to a reference standard, of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet. For example, flight level (FL) 250 represents a barometric altimeter indication of 25,000 feet; FL365, indicates that an aircraft is flying at an altitude of 36,500 feet.

GLIDESLOPE: Provides vertical guidance for aircraft during approach and landing. The glideslope/glidepath is based on the following:

a. Electronic components emitting signals which provide vertical reference to airborne instruments during instrument approaches such as ILS/MLS, or
b. Visual ground aids, such as VASI, which provide vertical guidance for a VFR approach or for the visual portion of an instrument approach and landing.

HEADING: A specific indication on the compass of the aircraft's flight direction with each heading given in degrees. There are 360 degrees on a compass.

IFR CONDITIONS: Weather conditions below the minimum for flight under visual flight rules (VFR), during which the pilot flies with the assistance of specific instruments.

INSTRUMENT FLIGHT RULES (IFR): Rules governing the procedures for conducting instrument flight. Also, a term used by pilots and controllers to indicate type of flight plan.

INSTRUMENT LANDING SYSTEM (ILS): A precision instrument approach system which normally consists of the following electronic components and visual aids:

a. Localizer
b. Glideslope
c. Outer Marker
d. Middle Marker
e. Approach Lights

LOCALIZER: The component of an ILS that provides course guidance to the runway.

MAINTAIN:

a. Concerning altitude/flight level, the term means to remain at the altitude/flight level specified. The phrase "climb and" or "descend and" normally precedes "maintain" and the altitude assignment; e.g. "descend and maintain 5000."
b. Concerning other ATC instructions, the term is used in its literal sense to "continue its use" or "maintain VFR".

ATC DICTIONARY (continued)

OUTER MARKER: A marker beacon at or near the glide slope intercept altitude of an ILS approach. It is keyed to transmit two dashes per second on a 400 HZ tone, which is received aurally and visually by compatible airborne equipment. The OM is normally located 4 to 7 miles from the runway threshold on the extended centerline of the runway.

RADAR: A device which measures the time interval between transmission and reception of radio pulses and correlates the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation of objects in the path of the transmitted pulses.

RADAR CONTACT: A phrase used by ATC to inform an aircraft that it is identified on the radar display, and that radar flight tracking will be provided until radar identification is terminated or lost. Radar service may also be provided within the limits of necessity and capability. When a pilot is informed of "radar contact," he/she automatically discontinues reporting over compulsory reporting points.

RADAR IDENTIFICATION: The process of ascertaining that an observed radar target is the radar return from a particular aircraft.

RADIO: A device used for communication.

RUNWAY: A defined rectangular area on a land airport prepared for the landing and takeoff of aircraft along its length. Runways are normally numbered in relation to their magnetic direction rounded off to the nearest 10 degrees; e.g. runway 05 is 50 degrees on the compass or in the northeast direction; runway 27 is 270 degrees on the compass or pointing toward the west.

TAXI: The movement of an airplane under its own power on the surface of an airport. Also, it describes the surface movement of helicopters equipped with wheels.

VECTOR: A turn issued to an aircraft to provide navigational guidance by air traffic controller via the radar.

VISUAL FLIGHT RULES: Rules that govern the procedures for conducting flight under visual conditions. The term "VFR" is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate the type of flight plan.

Air Traffic Control Instruction Challenge

Directions: Air traffic controllers use a special language when communicating with pilots. Use the ATC Dictionary from the previous pages to help you translate the communications below. Check your translating skills with the answer key that follows. Remember "read backs" are required. (A "read back" is when the controller or pilot repeats back what was said.)

1. Pilot: This is Universal Air 1224 gate 56 with 'Alpha' information, ready to taxi.

   ATC: *Universal Air 1224, taxi to runway one right.*

   Pilot: Universal Air 1224, Roger, taxi to runway one right.

   Your Translation:

   Pilot:

   ATC:

   Pilot:

2. Pilot: Universal Air 1224, One right, ready for takeoff.

   ATC: *Universal Air 1224, Runway one right cleared for takeoff.*

   Your Translation:

   Pilot:

   ATC:

3. ATC: *Universal Air 1224, contact Bay Departure on one-two-zero-point-niner.*

   Pilot: Roger, changing frequencies to one - two - zero - point - niner.

   Your Translation:

   ATC:

   Pilot:

Air Traffic Control Instruction Challenge (continued)

4. Pilot: Bay Departure this is Universal Air 1224, out of one thousand feet, climbing to one-zero-thousand.

   ATC: *Universal Air 1224, radar contact.*

   Your translation:

   Pilot:

   ATC:

5. ATC: *Universal Air 1224, turn right heading zero-three-zero, vector to Linden.*

   Pilot: Universal Air 1224, Roger, turning right heading zero-three-zero.

   Your translation:

   ATC:

   Pilot:

6. ATC: *Universal Air 1224, climb and maintain one-one-thousand. Expect flight level two-three-zero in five minutes.*

   Pilot: Universal Airlines 1224, Roger, maintain one-one-thousand expect flight level two-three-zero in five minutes.

   Your translation:

   ATC

   Pilot

Air Traffic Control Instruction Challenge (continued)

7. ATC: *Universal Air 1224, descend and maintain flight level two-four-zero.*

   Pilot: Universal Air 1224, descend and maintain flight level two-four-zero. Leaving flight level three-niner-zero.

   Your translation:

   ATC

   Pilot

8. Pilot: Bay Approach, Universal Air 1224 out of one-five-thousand descending to one-one-thousand with information "alpha".

   ATC: *Universal Air 1224, Roger fly heading two-four-zero, vector to I-L-S runway two-eight right, final approach course. Maintain seven thousand.*

   Pilot: Roger heading two-four-zero to maintain seven thousand.

   Your translation:

   Pilot:

   ATC:

   Pilot:

9. ATC: *Universal Air 1224, descend and maintain four thousand.*

   Pilot: Universal Airlines 1224, Roger, descending to four thousand.

   Your Translation:

   ATC:

   Pilot:

Air Traffic Control Instruction Challenge (continued)

10. ATC: *Universal Air 1224, three miles from the outer marker turn right heading two-six-zero, maintain four thousand until established on the localizer cleared I-L-S runway two-eight, right approach.*

    Pilot: Roger heading two-six-zero, four thousand until established, cleared I-L-S runway two-eight right approach.

    ATC: *Contact San Francisco Tower on one-two-zero-point-five.*

    Pilot: Roger, Tower, on one-two-zero-point-five.

    Your Translation:

    ATC:

    Pilot:

    ATC:

    Pilot:

11. Pilot: San Francisco Tower this is Universal Air 1224, over the outer marker.

    ATC: *Universal Air 1224, wind two-four-zero at one-zero, cleared to land runway two-eight right.*

    Pilot: Roger, cleared to land two-eight right.

    Your Translation:

    Pilot:

    ATC:

    Pilot:

Air Traffic Control Instruction Challenge - Key

Directions: Air traffic controllers use a special language when communicating with pilots. Use the ATC Dictionary from the previous pages to help you translate the communications below. Check your translating skills with the answer key that follows. Remember "read backs" are required. (A "read back" is when the controller or pilot repeats back what was said.)

1. Pilot: This is Universal Air 1224 gate 56 with 'Alpha' information, ready to taxi.

   ATC: Universal Air 1224, taxi to runway one right.

   Pilot: Universal Air 1224, Roger, taxi to runway one right.

   Your Translation:

   Pilot: *I've listened to the automated terminal information. Can I push back and taxi to my runway?*

   ATC: *Yes, take the taxiway to runway 1 and use the runway on the right.*

   Pilot: *OK, I'll take the taxiway to runway 1 and use the runway on the right.*

2. Pilot: Universal Air 1224, One right, ready for takeoff.

   ATC: Universal Air 1224, Runway one right cleared for takeoff.

   Your Translation:

   Pilot: *I'm here on runway one at the right. Can I take off now?*

   ATC: *Yes, I see you on runway one on the right. You can take off now.*

3. ATC: Universal Air 1224, contact Bay Departure on one-two-zero-point-niner.

   Pilot: Roger, changing frequencies.

   Your Translation:

   ATC: *Universal Air 1224, change your radio frequency to 120.9 and call the controller at Bay Departure.*

   Pilot: *OK, I'm changing my radio frequency.*

Air Traffic Control Instruction Challenge - Key (continued)

4. Pilot: Bay Departure this is Universal Air 1224, out of one thousand feet, climbing to one-zero-thousand.

   ATC: Universal Air 1224, radar contact.

   Your translation:

   Pilot: *Hello, Bay Departure, this is Universal Air 1224. I'm climbing through 1,000 feet on my way up to 23,000 feet.*

   ATC: *Hello, Universal Air 1224. I see you on my RADAR screen.*

5. ATC: Universal Air 1224, turn right heading zero-three-zero vector to Linden.

   Pilot: Universal Air 1224, Roger, turning right heading zero-three-zero.

   Your translation:

   ATC: *Universal Air 1224, follow your compass heading to 30 degrees for a route heading to Linden (which is 0 3 0)*

   Pilot: *OK, I'm turning to a heading of 30 degrees.*

6. ATC: Universal Air 1224, climb and maintain one-one-thousand. Expect flight level two-three-zero in five minutes.

   Pilot: Universal Airlines 1224, Roger, maintain one-one-thousand expecting flight level two-three-zero in five minutes.

   Your translation:

   ATC: *Universal Air 1224, climb and stay at 11,000 feet and then in about 5 minutes expect me to direct you to climb to 23,000 feet.*

   Pilot: *OK, Universal Air 1224 will remain at 11,000 feet and then in about 5 minutes will expect you to direct me to climb to 23,000 feet.*

Air Traffic Control Instruction Challenge - Key (continued)

7. ATC: Universal Air 1224, descend and maintain flight level two-four-zero.

   Pilot: Universal Air 1224, descend and maintain flight level two-four-zero. Leaving flight level three-niner-zero.

   Your translation:

   ATC: *Universal Air 1224, lower your altitude to 24,000 feet and stay there until I give you further notice.*

   Pilot: *OK, I'm now descending from 39,000 feet to 24,000 feet.*

8. Pilot: Bay Approach, Universal Air 1224 out of one-five-thousand descending to one-one-thousand with information "alpha".

   ATC: Universal Air 1224, Roger fly heading two-four-zero vector to I-L-S runway two- eight right, final approach course. Maintain seven thousand.

   Pilot: Roger heading two-four-zero to maintain seven thousand.

   Your translation:

   Pilot: *Hello, Controller at Bay Approach, this is Universal Air 1224. I am flying from 15,000 feet descending to 11,000 feet. I have already called the airport's automated terminal information and have information alpha.*

   ATC: *Universal Air 1224, yes, fly a compass heading of 240 degrees and use your instrument landing system on runway 28, the runway on the right. This is your final approach course. Stay at 7,000 feet.*

   Pilot: *Yes, I'll be on the compass heading of 240 degrees and stay at 7,000 feet.*

9. ATC: Universal Air 1224, descend and maintain four thousand.

   Pilot: Universal Airlines 1224, Roger, descending to four thousand.

   Your Translation:

   ATC: *Universal Air 1224, lower your altitude to 4,000 feet.*

   Pilot: *This is Universal Air 1224. Yes, I am lowering my altitude to 4,000 feet.*

Air Traffic Control Instruction Challenge - Key (continued)

10. ATC: Universal Air 1224, three miles from the outer marker turn right heading two-six-zero, maintain four thousand until established on the localizer cleared I-L-S runway two-eight, right approach.

Pilot: Roger heading two-six-zero, four thousand until established, cleared I-L-S runway two-eight right approach.

ATC: Contact San Francisco Tower on one-two-zero-point-five.

Pilot: Roger, Tower, on one-two-zero-point-five.

Your Translation:

ATC: *Universal Air 1224, you are three miles from the outer marker. Dial your compass heading to 260 and stay at 4,000 feet elevation. Stay on this course and altitude until course guidance system tells you that it is ok for you to use the instrument landing system for runway 28, on the right.*

Pilot: *Yes, I'm on the compass heading of 260 and flying at 4,000 feet until it is alright for me to use the instrument landing system and land on runway 28 using the runway on the right.*

ATC: *Change your radio frequency to 120.5 and call the controller at the San Francisco Tower.*

Pilot: *Yes, I will call the San Francisco control tower on the frequency of 120.5*

11. Pilot: San Francisco Tower this is Universal Air 1224, over the outer marker.

ATC: Universal Air 1224, wind two-four-zero at one-zero, cleared to land runway two-eight right.

Pilot: Roger, cleared to land two-eight right.

Your Translation:

Pilot: *Hello, tower controller at San Francisco Airport. This is Universal Air flight 1224. I am flying over the point of the glide slope intercept (outer marker).*

ATC: *Universal Air flight 1224, the wind is blowing from the southwest at a speed of 10 knots. You have permission to land on runway 28, on the right.*

Pilot: *Yes, I have permission to land on runway 28, on the right.*

Know Your A-B-Cs

Directions: All air traffic controllers communicate using a special alphabet. Each letter of the alphabet is designated by one particular word. Because many letters sound the same (for example "B" and "D") controllers never say a letter, they use a designated word that begins with that letter to stand for that letter. This alphabet code (written below) is called ICAO phonetics (International Civil Aviation Organization). Use this list to help you perform the word exercises on the next page.

ICAO Phonetics

Letter	Word Designation	Pronunciation (**bold** is accented syllable)
A	ALPHA	**AL-**FAH
B	BRAVO	**BRAH-**VOH
C	CHARLIE	**CHAR-**LEE
D	DELTA	**DELL-**TAH
E	ECHO	**ECK**-OH
F	FOXTROT	**FOKS-**TROT
G	GOLF	**GOLF**
H	HOTEL	HOH-**TELL**
I	INDIA	**IN-**DEE-AH
J	JULIETT	**JEW-**LEE -ETT
K	KILO	**KEY-**LOH
L	LIMA	**LEE-**MAH
M	MIKE	MIKE
N	NOVEMBER	NO-**VEM-**BER
0	OSCAR	**OSS-**CAH
P	PAPA	PAH-**PAH**
Q	QUEBEC	KEH-**BECK**
R	ROMEO	**ROW-**ME-OH
S	SIERRA	SEE-**AIR-**AH
T	TANGO	**TANG-**GO
U	UNIFORM	**YOU**-NEE-FORM
V	VICTOR	**VIK-**TOR
W	WHISKEY	**WISS-**KEY
X	X-RAY	**ECKS-**RAY
Y	YANKEE	**YAN**G-KEY
Z	ZULU	**ZOO-**LOO

Know Your A-B-Cs (continued)

Directions: Use the alphabet code from the previous page to help you spell out the words below. Then check your work with the key on the following page.

1. Alpha-India-Romeo-Papa-Lima-Alpha-November-Echo

   _____

2. Delta-Echo-Papa-Alpha-Romeo-Tango-Uniform-Romeo-Echo

   _____

3. Foxtrot-Lima-India-Golf-Hotel-Tango Papa-Lima-Alpha-November

   _____ _____

4. Foxtrot-Romeo-Echo-Quebec-Uniform-Echo-November-Charlie-Yankee

   _____

5. Tango-Oscar-Whiskey-Echo-Romeo

   _____

Directions: Use the alphabet code from the previous page to help you spell each word below. Then check your work with the key on the following page.

6. P-I-L-O-T

7. T-A-K-E-O-F-F

8. L-A-N-D-I-N-G

9. A-I-R-P-O-R-T

Know Your A-B-Cs - Key

Directions: Use the alphabet code from the previous page to help you spell out the words below.

1. Alpha-India-Romeo-Papa-Lima-Alpha-November-Echo

   airplane

2. Delta-Echo-Papa-Alpha-Romeo-Tango-Uniform-Romeo-Echo

   departure

3. Foxtrot-Lima-India-Golf-Hotel-Tango Papa-Lima-Alpha-November

   flight *plan*

4. Foxtrot-Romeo-Echo-Quebec-Uniform-Echo-November-Charlie-Yankee

   frequency

5. Tango-Oscar-Whiskey-Echo-Romeo

   tower

Directions: Use the alphabet code from the previous page to help you spell each word below. Then check your work with the key on the following page.

6. P-I-L-O-T *Papa - India - Lima - Oscar - Tango*

7. T-A-K-E-O-F-F *Tango - Alpha - Kilo - Echo - Oscar - Foxtrot - Foxtrot*

8. L-A-N-D-I-N-G *Lima - Alpha - November - Delta - India - November - Golf*

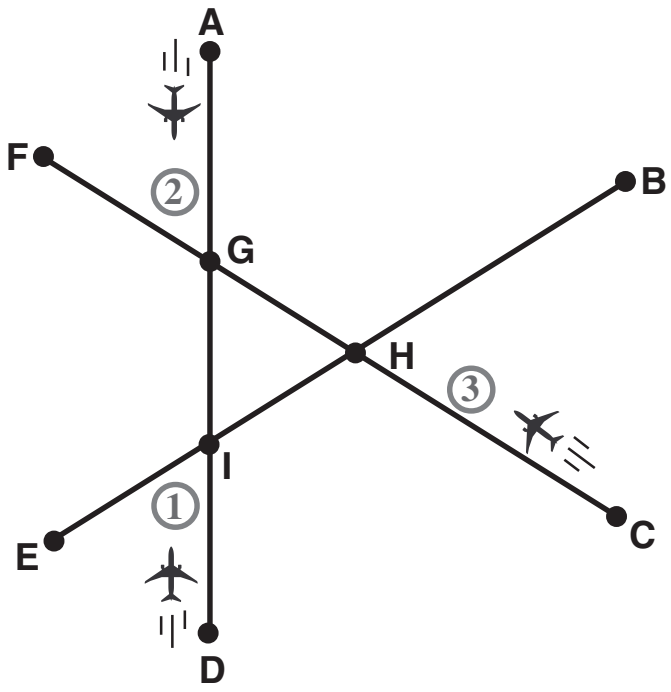
9. A-I-R-P-O-R-T *Alpha - India - Romeo - Papa - Oscar - Romeo - Tango*

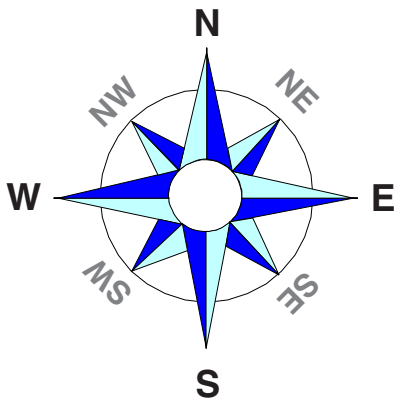
Heading and Course

Directions: Carefully study the figure below and the corresponding route of flight information. On the following pages answer each question using this information. Circle the letter of the correct answer. Then, check your answers using the answer key following this activity.

Flight Information

Aircraft Designation	Route
1	DIHB
2	AGIE
3	CHGF





Heading and Course

1. At what point will the routes of aircraft (2) and aircraft (3) intersect?

   A) **G** B) **H** C) **I**

2. After passing point **I**, in which direction will aircraft (1) be flying?

   A) **N** B) **NE** C) **NW**

3. At what point will the routes of aircraft (1) and aircraft (2) intersect?

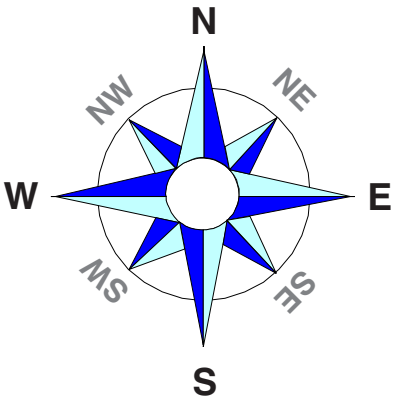
   A) **G** B) **H** C) **I**

4. After passing point **I**, in which direction will aircraft (2) be flying?

   A) **S** B) **SE** C) **SW**

5. At what point will the routes of aircraft (1) and (3) intersect?

   A) **G** B) **H** C) **I**



Heading and Course

6. Which aircraft maintains the same heading throughout this segment of the flight?

A) ① B) ② C) ③

7. Give the opposite direction from which aircraft ③ is heading.

A) **S** B) **SE** C) **SW**

8. Which aircraft begins with a heading of north and then adjusts its heading to northeast?

A) ① B) ② C) ③

9. Which aircraft begins with a heading of south and then adjusts its heading southwest?

A) ① B) ② C) ③

10. Give the direction in which aircraft ② does not fly.

A) **N** B) **SW** C) **S**

Heading and Course - Key

1. At what point will the routes of aircraft (2) and aircraft (3) intersect?

   A) **G** B) **H** C) **I**

2. After passing point **I**, in which direction will aircraft (1) be flying?

   A) **N** B) **NE** C) **NW**

3. At what point will the routes of aircraft (1) and aircraft (2) intersect?

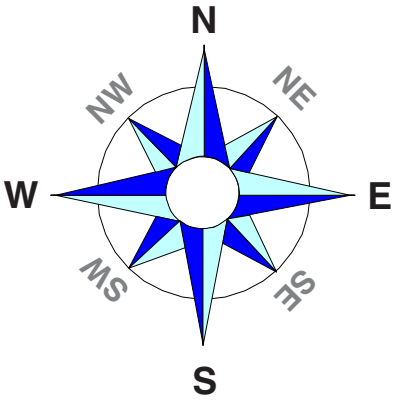
   A) **G** B) **H** C) **I**

4. After passing point **I**, in which direction will aircraft (2) be flying?

   A) **S** B) **SE** C) **SW**

5. At what point will the routes of aircraft (1) and (3) intersect?

   A) **G** B) **H** C) **I**



Heading and Course - Key

6. Which aircraft maintains the same heading throughout this segment of the flight?

A) 1 B) 2 C) **3**

7. Give the opposite direction from which aircraft 3 is heading.

A) **S** B) **SE** C) **SW**

8. Which aircraft begins with a heading of north and then adjusts its heading to northeast?

A) **1** B) 2 C) 3

9. Which aircraft begins with a heading of south and then adjusts its heading southwest?

A) 1 B) **2** C) 3

10. Give the direction in which aircraft 2 does not fly.

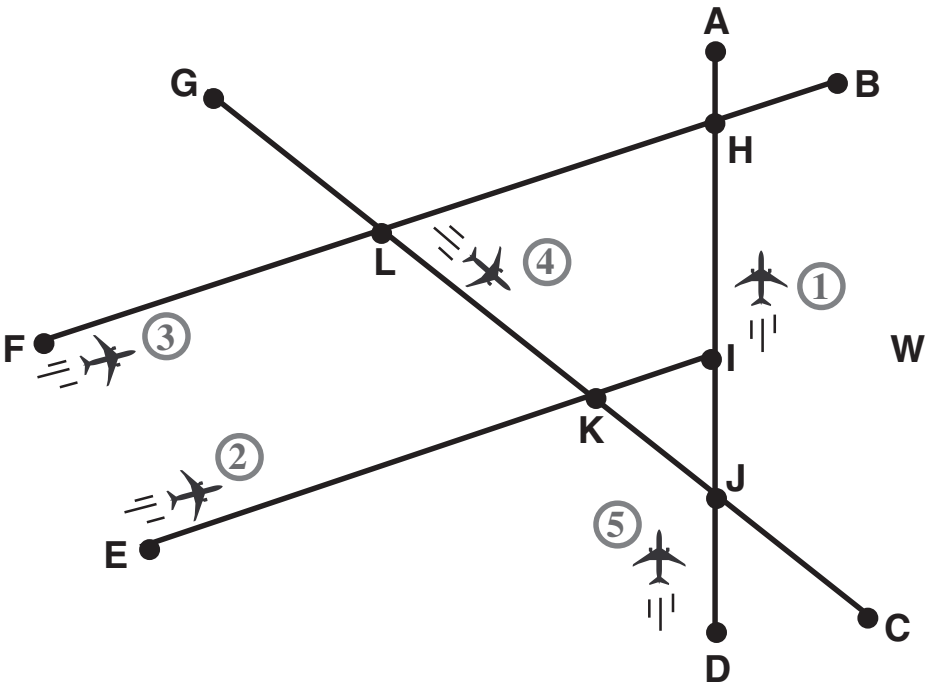
A) **N** B) **SW** C) **S**

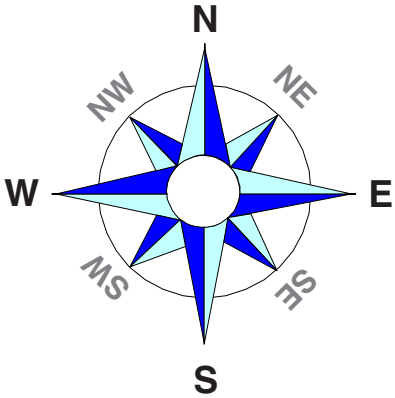
Maintaining Altitude

Directions: Carefully study the figure below and the corresponding route of flight and altitude information. On the following pages answer each question using all the information given. Circle the letter of the correct answer. Then, check your answers using the answer key following this activity.

Flight Information

Aircraft Designation	Route	Altitude
1	DIHB	30,000
2	EIHA	10,000
3	FLHB	20,000
4	GKJC	20,000
5	DJLG	30,000





Maintaining Altitude

1. The flight path of aircraft (4) will intersect the flight path of aircraft (2) at which point?

   A) **I** B) **J** C) **K**

2. If aircraft (5) and aircraft (2) arrive at point **K** at the same time, will they be in conflict? ("Conflict" is defined as the actual or possible loss of safe separation between aircraft. "Safe separation" is a distance of 1,000 feet vertically when flying below 29,000 feet.)

   A) **Yes** B) **No**

3. The flight paths of aircraft (1) and aircraft (3) will intersect at which point?

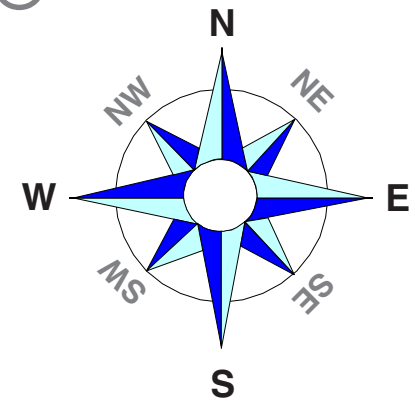
   A) **A** B) **H** C) **I**

4. Aircraft (3) requests a change of altitude at point **L** to 30,000 feet. If this request is approved with which aircraft will aircraft (3) then be in conflict?

   A) (1),(5) B) (2),(4) C) (4),(5)

5. Which 2 aircraft are heading north?

   A) (2),(3) B) (2),(5) C) (1),(5)



Maintaining Altitude

6. If aircraft (4) requests to change altitude to 25,000, aircraft (5) requests to change altitude to 25,000, and aircraft (2) requests to change altitude to 15,000, which 2 aircraft will be in conflict?

A) (4),(5) B) (2),(5) C) (4),(2)

7. Which 2 aircraft could request to climb to an additional 10,000 feet without the risk of putting themselves in conflict with other aircraft?

A) (1),(2) B) (2),(5) C) (1),(5)

8. Which aircraft have flight paths that include point L?

A) (3),(4) B) (3),(4),(5) C) (4),(5)

9. At which point do the flight paths of aircraft (1) and (5) diverge (separate)?

A) **I** B) **J** C) **K**

10. At which point do the flight paths of aircraft (1) and (2) first converge (come together)?

A) **I** B) **K** C) **H**

Maintaining Altitude - Key

1. The flight path of aircraft (4) will intersect the flight path of aircraft (2) at which point?

   A) I B) J C) **K**

2. If aircraft (5) and aircraft (2) arrive at point **K** at the same time, will they be in conflict? ("Conflict" is defined as the actual or possible loss of safe separation between aircraft. "Safe separation" is a distance of 1,000 feet vertically when flying below 29,000 feet.)

   A) **Yes** B) **No**

3. The flight paths of aircraft (1) and aircraft (3) will intersect at which point?

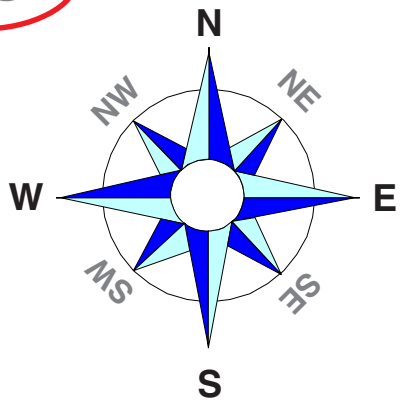
   A) **A** B) **H** C) **I**

4. Aircraft (3) requests a change of altitude at point **L** to 30,000 feet. If this request is approved with which aircraft will aircraft (3) then be in conflict?

   A) (1),(5) B) (2),(4) C) (4),(5)

5. Which 2 aircraft are at this point heading north?

   A) (2),(3) B) (2),(5) C) (1),(5)



Maintaining Altitude - Key

6. If aircraft (4) requests to change altitude to 25,000, aircraft (5) requests to change altitude to 25,000, and aircraft (2) requests to change altitude to 15,000, which 2 aircraft will be in conflict?

A) (4),(5) B) (2),(5) C) (4),(2)

7. Which 2 aircraft could request to climb to an additional 10,000 feet without the risk of putting themselves in conflict with other aircraft?

A) (1),(2) B) (2),(5) C) (1),(5)

8. Which aircraft have flight paths that include point L?

A) (3),(4) B) (3),(4),(5) C) (4),(5)

9. At which point do the flight paths of aircraft (1) and (5) diverge (separate)?

A) I B) J C) K

10. At which point do the flight paths of aircraft (1) and (2) first converge (come together)?

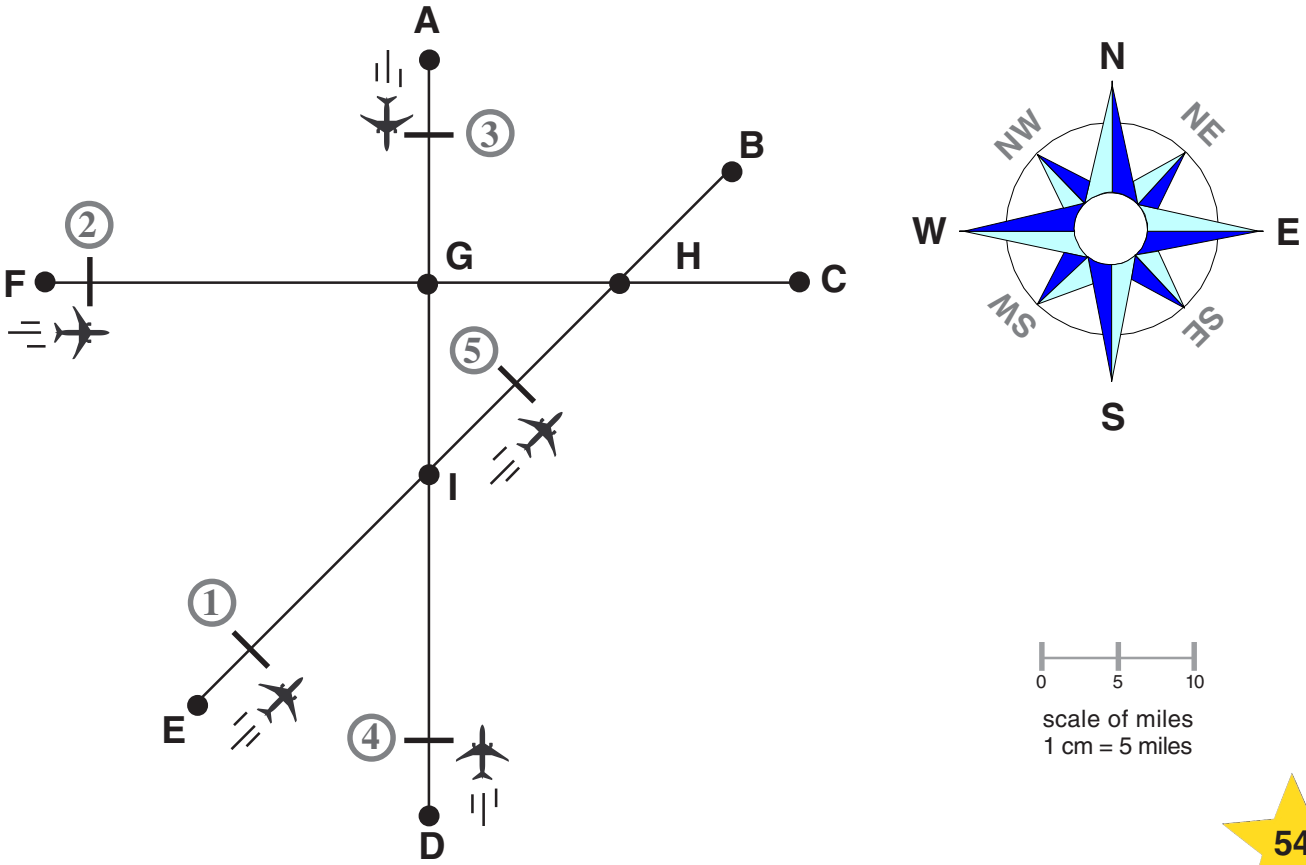
A) I B) K C) H

Speed Zone

Directions: Carefully study the figure below and the corresponding flight information. Answer each question on the following pages using the information given. Circle the letter of the correct answer. Then, check your answers using the answer key following this activity.

Flight Information

Aircraft Designation	Route	Altitude (in feet)	Speed (mph)
1	EIHC	12,000	300
2	FGHC	6,500	250
3	AGID	10,000	300
4	DIHB	6,500	250
5	EIHB	12,000	300



Speed Zone

1. Aircraft (1) requests to increase speed to 500 mph. If approved, aircraft (1) would be in conflict with which aircraft?

   A) (5) B) (4) C) (2)

2. Maintaining present heading, speed and altitude, which aircraft will reach point **I** first?

   A) (4) B) (3) (1)

3. Approximately how many miles apart are aircraft (1) and (5) ?

   A) **~ 5** B) **~ 20** C) **~ 50**

4. After aircraft (4) passes point **I**, how many aircraft will be flying to point B (including aircraft (4))?

   A) **1** B) **2** C) **3**

5. Which aircraft has a due south heading throughout its flight?

   A) (2) B) (3) C) (4)

Speed Zone

6. Aircraft (2) and aircraft (4) are the same distance from point **H**. Approximately how many miles away from point **H** is each aircraft?

A) **100** B) **70** C) **35**

7. Aircraft (2) and aircraft (4) are in conflict (They need to maintain a minimum separation of 1,000 feet.) To eliminate this conflict, to which altitude should aircraft (2) be directed?

A) **6,000** B) **7,000** C) **8,000**

8. How many aircraft have points **I - H - B** or **I - H - C** in their route of flight?

A) **2** B) **3** C) **4**

9. Aircraft (4) has requested to climb to 11,500 feet with an increase in speed to 400 mph at point I. If approved, aircraft (4) might come into conflict with which aircraft?

A) (1),(5) B) (5),(2) C) (3),(2)

10. At its present speed, approximately how long will it take aircraft (2) to reach point **C** ?

A) **~ 22 min.** B) **~ 30 min.** C) **~ 11 min.**

Speed Zone - Key

1. Aircraft (1) requests to increase speed to 500 mph. If approved, aircraft (1) would be in conflict with which aircraft?

   A) (5) B) (4) C) (2)

2. Maintaining present heading, speed and altitude, which aircraft will reach point **I** first?

   A) (4) B) (3) (1)

3. Approximately how many miles apart are aircraft (1) and (5) ?

   A) **~ 5** B) **~ 20** C) **~ 50**

4. After aircraft (4) passes point **I**, how many aircraft will be flying to point B (including aircraft (4))?

   A) **1** B) **2** C) **3**

5. Which aircraft has a due south heading throughout its flight?

   A) (2) B) (3) C) (4)

Speed Zone - Key

6. Aircraft (2) and aircraft (4) are the same distance from point **H** . Approximately how many miles away from point **H** is each aircraft?

A) **100** B) **70** C) **35**

7. Aircraft (2) and aircraft (4) are in conflict (They need to maintain a minimum separation of 1,000 feet.) To eliminate this conflict, to which altitude should aircraft (2) be directed?

A) **6,000** B) **7,000** C) **8,000**

8. How many aircraft have points **I - H - B** or **I - H - C** in their route of flight?

A) **2** B) **3** C) **4**

9. Aircraft (4) has requested to climb to 11,500 feet with an increase in speed to 400 mph at point I. If approved, aircraft (4) might come into conflict with which aircraft?

A) (1), (5) B) (5), (2) C) (3), (2)

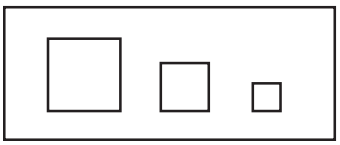
10. At its present speed, approximately how long will it take aircraft (2) to reach point **C** ?

A) **~ 22 min.** B) **~ 30 min.** C) **~ 11 min.**

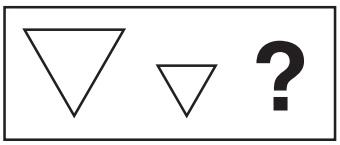
Symbolic Relationships

Directions: This activity checks your ability to recognize the similarity in the relationship between different groups of symbols. First, you are given a group of 3 symbols. These symbols are related in a specific way. The relationship might be connected to such things as size, placement, shape or pattern. The second group of symbols is incomplete. Your job is to choose which symbol from the third group will best complete the second group based upon the relationship established in the first group.

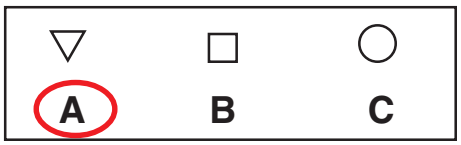
Look at the example below:



The first group of symbols is comprised of 3 boxes placed large to small.

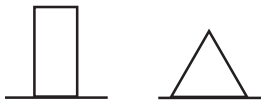
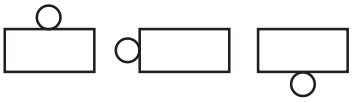
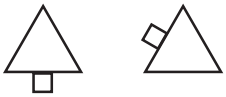
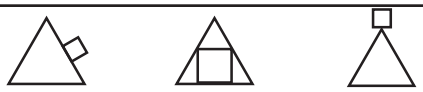
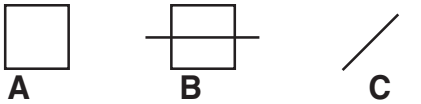
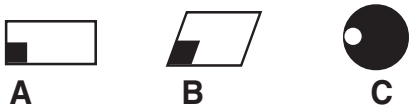
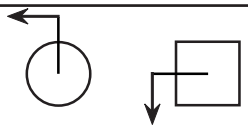
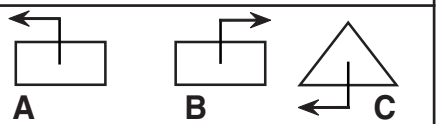


The second group of symbols is comprised of 2 triangles placed large to medium.

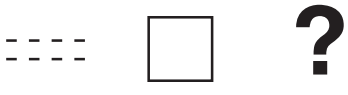
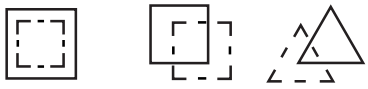
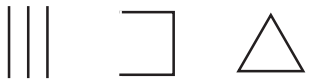
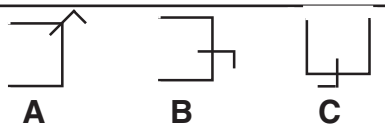


The correct answer is "A" because it completes the pattern of large to small.

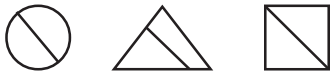
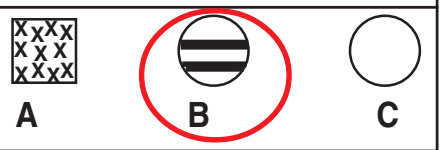
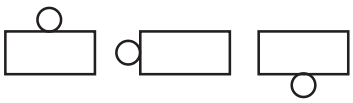
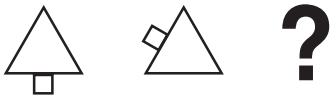
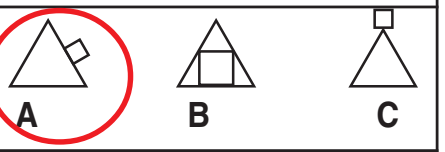
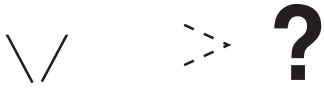
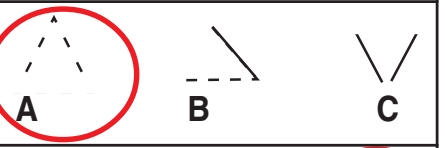
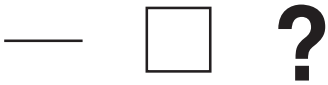
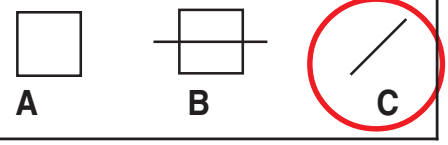
Symbolic Relationships

	Group 1	Group 2	Possible Answers
1.			 A B C
2.			 A B C
3.			 A B C
4.			 A B C
5.			 A B C
6.			 A B C
7.			 A B C
8.			 A B C
9.			 A B C

Symbolic Relationships

	Group 1	Group 2	Possible Answers
10.			 A B C
11.			 A B C
12.			 A B C
13.			 A B C
14.			 A B C
15.			 A B C

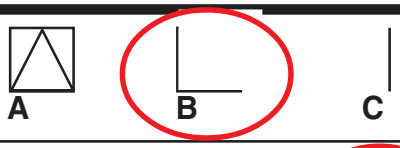
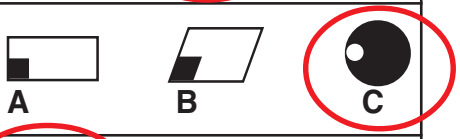
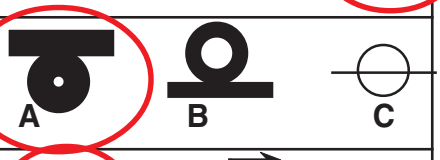
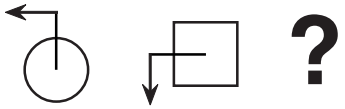
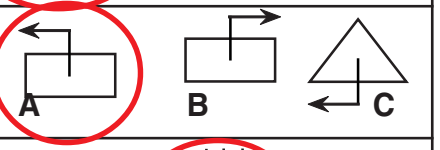
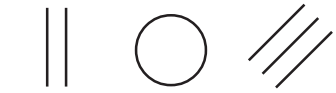
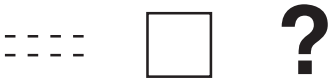
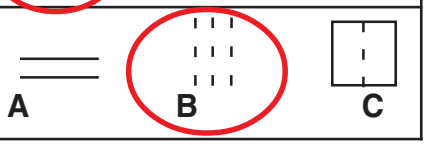
Symbolic Relationships - Key

	Group 1	Group 2	Possible Answers
1.			 A B C
2.			 A B C
3.			 A B C
4.			 A B C
5.			 A B C

Relationship Explanation

1. Shape with line.
2. Same shape with object(s) inside.
3. Larger identical shapes with smaller identical objects attached to side.
4. Object represented by solid lines then dotted lines.
5. Pattern of shape-line-shape-line-shape-line.

Symbolic Relationships - Key

	Group 1	Group 2	Possible Answers
6.			
7.			
8.			
9.			
10.			

Relationship Explanation

6. Shape with sides removed.

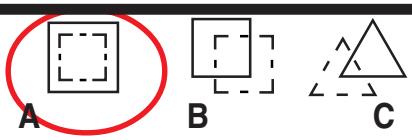
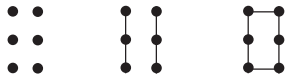
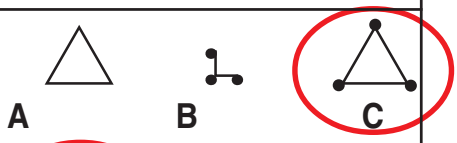
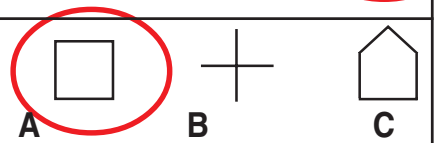
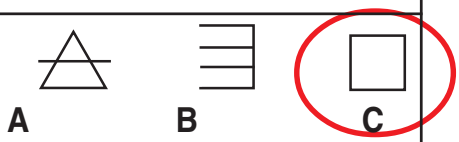
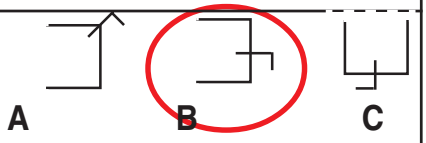
7. Larger white shape with similar smaller shaded shape is repeated with a negative (opposite) image.

8. Progressively thicker line with horizontal line rising a level.

9. Shapes with arrows pointing clockwise pattern repeated with counter-clockwise pattern.

10. 2 lines-shape-3 lines (solid then dotted).

Symbolic Relationships - Key

	Group 1	Group 2	Possible Answers
11.			 A B C
12.			 A B C
13.			 A B C
14.			 A B C
15.			 A B C

Relationship Explanation

11. Shapes with dotted lines (outside then inside).

12. Dots, dots connected into lines, dots connected into shapes.

13. Adding a line to each object.

14. Forming lines into open shape then closed shape.

15. Open shape with smaller line on one side is rotated clockwise.

Alphabet Soup

Directions: Recognizing patterns and sequencing are important thinking skills. Seeing the relationship in a series of letters is one indication of how well you make use of those skills. One key to solving letter relationship problems is to think of them as problems involving the relationship of numbers.

For example, we've assigned each letter of the alphabet with a number beginning with one. Use this as a key, and perhaps the patterns will become more obvious.

1	2	3	4	5	6	7	8	9	10	11	12	13
A	B	C	D	E	F	G	H	I	J	K	L	M
14	15	16	17	18	19	20	21	22	23	24	25	26
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

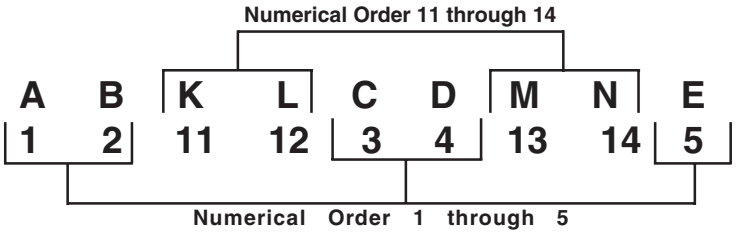
For example, look at the letter sequence below.

A B K L C D M ____ ____

Now look at it as numbers.

1 2 11 12 3 4 13 ____ ____

The next 2 letters to complete the sequence will be "N" and "E"



Alphabet Soup

Directions: Use the alphabet and its numeric form from the previous page to help you complete each sequence below. Check your answers using the answer key on the following page.

	Letter Sequence	Possible Answers (circle one pair)		
1.	Z A B X C D V ___ ___	F T	E F	G T
2.	B E H K N Q T ___ ___	W Z	U V	X Z
3.	A N B O C P D ___ ___	E Q	Q E	E R
4.	F G I J L M O ___ ___	P R	Q S	P T
5.	E E J J O O T ___ ___	S V	T X	T Y
6.	Z A X C V E T ___ ___	Q G	G R	H Q
7.	A D B E C F D ___ ___	G E	H G	F G
8.	Y T U P Q L M ___ ___	J I	G H	H I
9.	A Z Y B X W C ___ ___	T S	V U	U D
10.	C D F I M ___ ___	Z I	S Y	R X
11.	Z A Y C X E W ___ ___	G V	I U	G U
12.	A B L C D N E ___ ___	G Q	G P	F P
13.	C F L D H P E ___ ___	K S	J T	L U
14.	Z W T Y V S X ___ ___	U R	T Q	S R
15.	C F F I I I ___ ___	L L	M M	S S

Alphabet Soup - Key

Directions: Use the alphabet and its numeric form from the previous page to help you complete each sequence below. Check your answers using the answer key on the following page.

	Letter Sequence	Possible Answers (circle one pair)		
1.	Z A B X C D V ___ ___	F T	**E F**	G T
2.	B E H K N Q T ___ ___	**W Z**	U V	X Z
3.	A N B O C P D ___ ___	E Q	**Q E**	E R
4.	F G I J L M O ___ ___	**P R**	Q S	P T
5.	E E J J O O T ___ ___	S V	T X	**T Y**
6.	Z A X C V E T ___ ___	Q G	**G R**	H Q
7.	A D B E C F D ___ ___	**G E**	H G	F G
8.	Y T U P Q L M ___ ___	J I	G H	**H I**
9.	A Z Y B X W C ___ ___	T S	**V U**	U D
10.	C D F I M ___ ___	Z I	S Y	**R X**
11.	Z A Y C X E W ___ ___	**G V**	I U	G U
12.	A B L C D N E ___ ___	G Q	G P	**F P**
13.	C F L D H P E ___ ___	K S	**J T**	L U
14.	Z W T Y V S X ___ ___	**U R**	T Q	S R
15.	C F F I I I ___ ___	**L L**	M M	S S

Gate to Gate

Multimedia Student Logbook

Student Introduction

Welcome aboard ***Gate to Gate,*** a multimedia experience that introduces you to the air traffic management system: the people, tools and work of air traffic control. This experience is brought to you by the Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA). This Student Logbook is designed to enhance your multimedia experience as it relates to careers in air traffic management.

Air traffic is expected to continue to grow rapidly well into the 21st century. For this growth to occur without producing gridlock in the sky and at airports, the capacity of the air traffic control system must be increased substantially. NASA Ames Research Center in cooperation with the FAA continues to develop software tools and procedures to assist air traffic controllers in managing air traffic more efficiently throughout all phases of flight. These tools are known collectively as the Center TRACON Automation System or CTAS. The heart of CTAS is a set of trajectory prediction algorithms which combine air traffic control radar data, aircraft performance data, flight plans, and wind predictions to compute a predicted trajectory for every aircraft being tracked by the air traffic control facility. Two of these tools, the Traffic Management Advisor (TMA) and the Final Approach Spacing Tool (FAST), are being prepared for delivery within the next few years to select air traffic control facilities. These tools will assist in the Approach phase of flight. At the same time, long term efforts are being directed at the Departure and En Route phases of flight. These new tools and procedures will enable controllers to work together with airlines and pilots to reduce delays and improve the predictability of airspace operations while also reducing the controller workload.

The purpose of this CD-ROM, ***Gate to Gate***, is to familiarize you with the air traffic system as it operates today, and to demonstrate how some of these new tools fit into this system, providing a significant improvement in the flow of air traffic, thus allowing the capacity of the national airspace system to keep up with the demand from the traveling public.

This CD-ROM is divided into 7 sections: Preflight, Takeoff, Departure, En Route, Descent, Approach and Landing. Each section is a phase in a commercial flight profile. These sections give information about the air traffic management system's contribution to each phase of a commercial flight. A typical commercial flight profile is briefly summarized in section one "Student Activity Packet" on pages 9-10.

Each of the 7 sections is then divided into 4 additional segments. The first segment identifies the people involved with this phase of the flight. These are the controllers who are directing the commercial aircraft during this time. The second segment focuses on the tools that the controllers utilize during this phase of the flight. The tools can be as simple as binoculars and as complex as computer software designed to analyze the air traffic flow across the nation. The third segment of each section is an In-depth Question. This segment delves into one aspect of this phase of the flight and provides a little more detailed information. If you have an appreciation for trivia then segment four, Factoid, will be entertaining for you.

As you fly through each flight phase (or as you move through each section of the multimedia experience), you can interact with what you are learning through the Student Logbook. If you want to know more, your career guidance specialist can provide you with additional information. Also, throughout the Student Logbook there will be references to additional resources.

It appears you already have your ticket for this flight, so let's get you on board and to your seat. Enjoy your flight from ***Gate to Gate***!

Preflight

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 73.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" pages 13-14, "The Many Roles of an Air Traffic Controller" or page 15 "How It All Works Together" or pages 24-26, "Reading a Strip".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Preflight**.**

___ Approach Controller

___ Center Controller

___ Clearance Delivery

___ Departure Controller

___ Ground Controller

___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Preflight**.**

___ Air Route Traffic Control Center (ARTCC)

___ Air Traffic Control Tower (ATCT)

___ Flight Service Station (FSS)

___ Terminal Radar Approach CONtrol (TRACON)

Preflight (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 74.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Preflight**.**

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ binoculars

___ conflict prediction software

___ eyes

___ Final Approach Spacing Tool (FAST)

___ radar scope/radar system

___ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth Question

4. In your own words, what is a strip and for what purpose is it used?
(If you want to know more about a "strip", see section one "Student Activity Packet" pages 24-26, "Reading a Strip".)

Factoid

5. How many flight plans are filed on an average day in the United States?

Preflight - Key

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 73.
If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" pages 13-14, "The Many Roles of an Air Traffic Controller" or page 15" How It All Works Together" or pages 24-26, "Reading a Strip".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Preflight**.**

___ Approach Controller
___ Departure Controller
___ Center Controller
___ Ground Controller
✔ Clearance Delivery
✔ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Preflight**.**

___ Air Route Traffic Control Center (ARTCC)
✔ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
___ Terminal Radar Approach CONtrol (TRACON)

Preflight - Key (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 74.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Preflight**.**

✔ Airport Surface Detection Equipment (ASDE or surface radar)

✔ binoculars

___ conflict prediction software

✔ eyes

___ Final Approach Spacing Tool (FAST)

___ radar scope/radar system

✔ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth Question

4. In your own words, what is a strip and for what purpose is it used?
(If you want to know more about a "strip", see section one "Student Activity Packet" pages 24-26, "Reading a Strip".)

After a flight plan is entered into the main computer, all essential information about a flight will be printed on a piece of paper called a strip. The main computer distributes this information in advance to all controllers along the airplane's rate of flight. The airplane is tracked, monitored and directed according to the requested flight plan information and the ever changing traffic picture of live air traffic.

Factoid

5. How many flight plans are filed on an average day in the United States?

68,000 flight plans are filed on the average day.

Takeoff

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 77.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" pages 13-14, "The Many Roles of an Air Traffic Controller" or page 15 "How It All Works Together" or pages 20-22, "Mapping from Memory".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Takeoff.

___ Approach Controller

___ Center Controller

___ Clearance Delivery

___ Departure Controller

___ Ground Controller

___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Takeoff**.**

___ Air Route Traffic Control Center (ARTCC)

___ Airport Control Tower

___ Flight Service Station (FSS)

___ Terminal Radar Approach CONtrol (TRACON)

Takeoff (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 78.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Takeoff.

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ binoculars

___ conflict prediction software

___ eyes

___ Final Approach Spacing Tool (FAST)

___ radar scope/radar system

___ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

4. List the 5 factors that can delay the takeoff of an aircraft.

Factoid

5. What is the average time it takes an airplane to move from the terminal to the runway?

Takeoff - Key

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 77.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" pages 13-14, "The Many Roles of an Air Traffic Controller" or page 15 "How It All Works Together" or pages 20-22, "Mapping from Memory".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Takeoff.

___ Approach Controller
___ Center Controller
___ Clearance Delivery
___ Departure Controller
___ Ground Controller
✔ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Takeoff.

___ Air Route Traffic Control Center (ARTCC)
✔ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
___ Terminal Radar Approach CONtrol (TRACON)

Takeoff - Key (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 78.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Takeoff.

✔ Airport Surface Detection Equipment (ASDE or surface radar)

✔ binoculars

___ conflict prediction software

✔ eyes

___ Final Approach Spacing Tool (FAST)

✔ radar scope/radar system

✔ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

4. List the 5 factors that can delay the takeoff of an aircraft.

- *Weather delays at the destination airport*
- *Weather deviations during the En Route phase of the flight*
- *Weather delays at the departure airport*
- *Too many airplanes scheduled to depart at the same time*
- *Unscheduled mechanical maintenance*

Factoid

5. What is the average time it takes an airplane to move from the terminal to the runway?

From the time the door on the airplane is closed, through push back from the gate, then taxiing time, the average time it takes is 14 and 1/2 minutes.

Departure

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 81.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" pages 13-14, "The Many Roles of an Air Traffic Controller" or page 15 "How It All Works Together" or pages 44-48, "Heading and Course" or pages 65-67 "Alphabet Soup"

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Departure.

___ Approach Controller
___ Center Controller
___ Clearance Delivery
___ Departure Controller
___ Ground Controller
___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Departure.

___ Air Route Traffic Control Center (ARTCC)
___ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
___ Terminal Radar Approach CONtrol (TRACON)

Departure (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 82.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Departure.

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ binoculars

___ data tag

___ eyes

___ Final Approach Spacing Tool (FAST)

___ radar scope/radar system

___ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

4. In your own words define "airspace". How many "Centers" comprise the United States' airspace? *(If you want to know more about airspace, see section one "Student Activity Packet" pages 27-29, "Know Your Airspace".)*

Factoid

5. How many TRACONs are there in the contiguous United States?

Departure - Key

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 81.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" pages 13-14, "The Many Roles of an Air Traffic Controller" or page 15" How It All Works Together" or pages 44-48, "Heading and Course" or pages 65-67 "Alphabet Soup")

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Departure.

___ Approach Controller
✔ Departure Controller
___ Center Controller
___ Ground Controller
___ Clearance Delivery
___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Departure.

___ Air Route Traffic Control Center (ARTCC)
___ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
✔ Terminal Radar Approach CONtrol (TRACON)

Departure Key (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 82.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Departure.

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ binoculars

✔ data tag

___ eyes

___ Final Approach Spacing Tool (FAST)

✔ radar scope/radar system

✔ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

4. In your own words define "airspace". How many "Centers" comprise the United States' airspace? *(If you want to know more about airspace, see section one "Student Activity Packet" pages 27-29, "Know Your Airspace".)*

The space above a nation where aircraft fly.

21 Centers (ARTCC or Air Route Traffic Control Centers) includes the 48 contiguous states (which have 20 Centers) plus Alaska's Center in Anchorage.

Factoid

5. How many TRACONs are there in the contiguous United States?

184 TRACONs in the contiguous United States.

En Route

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 85.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" page 13-14, "The Many Roles of an Air Traffic Controller" or page 15 "How It All Works Together" or pages 27-29 "Know Your Airspace".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, En Route.

___ Approach Controller

___ Center Controller

___ Clearance Delivery

___ Departure Controller

___ Ground Controller

___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during En Route.

___ Air Route Traffic Control Center (ARTCC)

___ Air Traffic Control Tower (ATCT)

___ Flight Service Station (FSS)

___ Terminal Radar Approach CONtrol (TRACON)

En Route (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 86.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, En Route.

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ conflict prediction software

___ Final Approach Spacing Tool (FAST)

___ radar scope/radar system

___ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

4. Give the distances of vertical and horizontal separation for below and above 29,000 feet altitude. *(If you want to know more about maintaining safe separation see section one, "Student Activity Packet", pages 49-58, "Maintaining Altitude" and "Speed Zone".)*

Factoid

5. On average, how many airplanes are in the United States' airspace during peak travel hours?

En Route - Key

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 85.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" page 13-14, "The Many Roles of an Air Traffic Controller" or page 15 "How It All Works Together" or pages 27-29, "Know Your Airspace".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, En Route.

___ Approach Controller
___ Departure Controller
✔ Center Controller
___ Ground Controller
___ Clearance Delivery
___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during En Route.

✔ Air Route Traffic Control Center (ARTCC)
___ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
___ Terminal Radar Approach CONtrol (TRACON)

En Route - Key (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 86.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, En Route.

___ Airport Surface Detection Equipment (ASDE or surface radar)

✔ conflict prediction software

___ Final Approach Spacing Tool (FAST)

✔ radar scope/radar system

✔ radio transmitters

✔ Traffic Management Advisor (TMA)

In-depth

4. Give the distances of vertical and horizontal separation for below and above 29,000 feet altitude. *(If you want to know more about maintaining safe separation see section one, "Student Activity Packet", pages 49-58, "Maintaining Altitude" and "Speed Zone".)*

Below 29,000 feet
Vertical separation is 1,000 feet
Horizontal separation is 5 nautical miles

Above 29,000 feet
Vertical separation is 2,000 feet
Horizontal separation is 5 nautical miles

Factoid

5. On average, how many airplanes are in the United States' airspace during peak travel hours?

Approximately 5,000 airplanes.

Descent

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 89.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" pages 13-14, "The Many Roles of an Air Traffic Controller" or page 15 "How It All Works Together" or pages 30-32, ATC Dictionary or pages 65-67 "Alphabet Soup".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Descent.

___ Approach Controller
___ Center Controller
___ Clearance Delivery
___ Departure Controller
___ Ground Controller
___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Descent.

___ Air Route Traffic Control Center (ARTCC)
___ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
___ Terminal Radar Approach CONtrol (TRACON)

Descent (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 90.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Descent.

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ binoculars

___ conflict prediction software

___ eyes

___ Final Approach Spacing Tool (FAST)

___ radar scope/radar system

___ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

1. Traffic Management Advisor (TMA) uses 5 pieces of information when making prediction's about an airplane's arrival time. List the 5 pieces of information.

Factoid

2. How many Air Route Traffic Control Centers (ARTCC or Centers) are there in the United States?

Descent - Key

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 89.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" page 13-14, "The Many Roles of an Air Traffic Controller" or page 15" How It All Works Together" or pages 30-32, ATC Dictionary or pages 65-67 "Alphabet Soup".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Descent.

___ Approach Controller
___ Departure Controller
✔ Center Controller
___ Ground Controller
___ Clearance Delivery
___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Descent.

✔ Air Route Traffic Control Center (ARTCC)
___ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
___ Terminal Radar Approach CONtrol (TRACON)

Descent - Key (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 90.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Descent.

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ binoculars

___ conflict prediction software

___ eyes

___ Final Approach Spacing Tool (FAST)

✔ radar scope/radar system

✔ radio transmitters

✔ Traffic Management Advisor (TMA) tool

In-depth

4. Traffic Management Advisor (TMA) uses 5 pieces of information when making predictions about an airplane's arrival time. List the 5 pieces of information.

- *The airplane's present position*
- *The aircraft's performance characteristics*
- *The airplane's route of flight*
- *The weather conditions*
- *Any preferences the airline might have about how the airplane is to be operated*

Factoid

5. How many Air Route Traffic Control Centers (ARTCC or Centers) are there in the United States?

There are 21 Centers in the United States
(with 20 Centers in the contiguous United States).

Approach

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 93.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" page 13-14, "The Many Roles of an Air Traffic Controller" or page 15" How It All Works Together" or pages 33-40, "Air Traffic Control Instruction Challenge".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Approach.

___ Approach Controller
___ Center Controller
___ Clearance Delivery
___ Departure Controller
___ Ground Controller
___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Approach.

___ Air Route Traffic Control Center (ARTCC)
___ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
___ Terminal Radar Approach CONtrol (TRACON)

Approach (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 94.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Approach.

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ binoculars

___ conflict prediction software

___ eyes

___ Final Approach Spacing Tool (FAST)

___ radar scope/radar system

___ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

1. Why is a small airplane not allowed to follow any closer than 5 or 6 miles behind a much larger airplane?

Factoid

5. Approximately how many air traffic controllers are employed in the United States?

Approach - Key

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 93.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" pages 13-14, "The Many Roles of an Air Traffic Controller" or page 15 "How It All Works Together" or pages 33-40, "Air Traffic Control Instruction Challenge".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Approach.

✔ Approach Controller	___ Departure Controller
___ Center Controller	___ Ground Controller
___ Clearance Delivery	___ Local Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Approach.

___ Air Route Traffic Control Center (ARTCC)

___ Air Traffic Control Tower (ATCT)

___ Flight Service Station (FSS)

✔ Terminal Radar Approach CONtrol (TRACON)

Approach - Key (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 94.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Approach.

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ binoculars

___ conflict prediction software

___ eyes

✔ Final Approach Spacing Tool (FAST)

✔ radar scope/radar system

___ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

4. Why is a small airplane not allowed to follow any closer than 5 or 6 miles behind a much larger airplane?

Every airplane leaves trailing behind it wake turbulence. This turbulence can cause very powerful and quick changes in the flow of air. These powerful changes in air flow can severely disrupt an airplane's flight causing its flight to become quite unstable.

Factoid

5. Approximately how many air traffic controllers are employed in the United States?

There are approximately 19,000 air traffic controllers employed in the United States working in Air Traffic Control Towers (ATCT), Centers and TRACONs.

Landing

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 97.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" pages 13-14, "The Many Roles of an Air Traffic Controller" or page 15" How It All Works Together" or pages 20-22, "Mapping from Memory".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Landing.

___ Approach Controller
___ Center Controller
___ Clearance Delivery
___ Departure Controller
___ Ground Controller
___ Tower Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Landing.

___ Air Route Traffic Control Center (ARTCC)
___ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
___ Terminal Radar Approach CONtrol (TRACON)

Landing (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 98.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Landing.

___ Airport Surface Detection Equipment (ASDE or surface radar)

___ binoculars

___ conflict prediction software

___ eyes

___ Final Approach Spacing Tool (FAST)

___ radar scope/radar system

___ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

4. How does a pilot land an airplane when it is difficult to see the runway?

Factoid

5. Each year new air traffic control towers are being built. Up until the year 2000, where was the tallest airport control tower in the United States located?

Landing - Key

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 97.
(If you want to know more about the work of air traffic controllers or the air traffic management system, see also section one "Student Activity Packet" page 13-14, "The Many Roles of an Air Traffic Controller" or page 15" How It All Works Together" or pages 20-22, "Mapping from Memory".)

People

1. Place a check in the blank next to the controllers who direct the aircraft during this part of the flight, Landing.

___ Approach Controller
___ Departure Controller
___ Center Controller
✔ Ground Controller
___ Clearance Delivery
✔ Tower Controller

2. Place a check in the blank next to the facility in which the previously checked controller(s) perform the air traffic management duties during Landing.

___ Air Route Traffic Control Center (ARTCC)
✔ Air Traffic Control Tower (ATCT)
___ Flight Service Station (FSS)
___ Terminal Radar Approach CONtrol (TRACON)

Landing - Key (continued)

Directions: As you interact with the multimedia CD-ROM ***Gate to Gate***, complete the comprehension check below. After completing each phase of the flight, check your understanding with the answer key on page 98.

Tools

3. Place a check in the blank next to the tool(s) that the controllers use during this part of the flight, Landing.

✔ Airport Surface Detection Equipment (ASDE or surface radar)

✔ binoculars

___ conflict prediction software

✔ eyes

___ Final Approach Spacing Tool (FAST)

___ radar scope/radar system

✔ radio transmitters

___ Traffic Management Advisor (TMA)

In-depth

4. How does a pilot land an airplane when it is difficult to see the runway?

The pilot uses the ILS or Instrument Landing System. This is a system of ground-based and aircraft instruments, radio signals and special runway lights.

Factoid

5. Each year new air traffic control towers are being built. Up until the year 2000, where was the tallest airport control tower in the United States located?

The tallest air traffic control tower in the United States was located at the airport in Denver, Colorado.

Gate to Gate

Additional Resources

Want to Know More?

If you wish to find more information on topics pertaining to careers in aeronautics, aviation and air traffic control, you can use this resource section to find helpful web sites, additional publications and a listing of associations and agencies.

Web Sites

Airline Handbook
http://www.air-transport.org/handbk/index.htm
A site full of great information about flight and air traffic control.

Airline Pilots Association International (ALPA)
http://www.alpa.org
This site gives information about the organization from air safety to special events.

Air Traffic Control Association (ATCA)
http://www.atca.org
This organization is dedicated to the science of air traffic control and includes information about the organization, upcoming events and other related developments.

Air Traffic Training Division Weekly Web
http://www.ama.500.jccbi.gov
Lots of information about the training programs available for air traffic control candidates.

Air Transport Association of America (ATA)
http://www.air-transport.org
This site features information about the air transport industry, events, publications and membership.

ATC Related Links
http://www.xnet.com/~crisj/links.html
Go here to find lots of links to ATC related sites.

CTAS: Center-TRACON Automation System
http://www.ctas.arc.nasa.gov/
Very thorough explanation of the new air traffic control tools being developed jointly by NASA and the FAA.

Denver Center
http://www.tc.faa.gov/ZDV
An informative site put out by the Denver Center giving information about the air traffic control system.

Department of Transportation
http://www.dot.gov
General information on this government agency with related links.

Web Sites (continued)

FAA Academy Homepage
http://www.academy.jccbi.gov/
Gives a complete overview of FAA training opportunities.

Federal Aviation Administration (FAA)
http://www.faa.gov
The official site for this government agency that provides information on careers, policies regarding flight standards, news releases, flight safety statistics and answers to frequently asked questions among many other things.

Mike Monroney Aeronautical Center: FAA
http:/www.mmac.jccbi.gov
This site offers information on the history of the center, its training programs, logistics center and its research.

National Air Traffic Controllers Association (NATCA)
http://home.natca.org/natca/
Find out about the bargaining unit for air traffic controllers as well as learn more about the work of controllers.

National Air Transportation Association (NATA)
http://www.NATA-online.org
Here you will find information about the organization and membership as well as education articles, publications and special events.

National Association of Air Traffic Specialists (NAATS)
http://www.naats.org/
Web site giving information about the labor organization representing the FAA's Flight Service Station (FSS) Specialists that includes updates and press releases as well as useful links.

Professional Airways System Specialists (PASS)
http://www.passnational.org
Homepage for the Professional Airways Systems Specialists organization whose membership includes aviation safety inspectors, facilities technicians, system specialists.

Web Sites (continued)

Professional Women Controllers, Inc.
http://www.procinc.org
An organization of men and women dedicated to being proactive, empowered with skills to make a difference; develop professionally and personally; achieve and value diversity and be examples of a quality work environment.

School of Aviation Science Air Traffic Control
http://www.aviation.wmich.edu/home.html
Western Michigan University's aviation program is featured.

Steve's Air Traffic Control and Aviation
http:www.atlascomm.net/faaflyer
The best part of this site is the list of all the fantastic links to other aviation and air traffic control sites as well as the ability to connect to a site that gives real audio of controller and pilot communication.

Publications

Air Traffic Control: An Invitation to a Career
Lawrence E. Gesell, 1988

Air Traffic Control: How to Become an FAA Air Traffic Controller
Walter S. Luffsey, 1990

Air Transportation: Foundations for the 21st Century
Paul Stephen Dempsey & Laurence E. Gesell, 1997

Avoiding Common Pilot Errors: An Air Traffic Controllers View
Tab Practical Flying Series
John Stewart, 1989

Dictionary of Air Transport and Traffic Control
Emanuel Benjamin Ocran, 1984

Flight to the Future: Human Factors in Air Traffic Control
Christopher D. Wickens (editor), 1997

Fundamentals of Air Traffic Control
Michael S. Nolan, 1994

The Future Air Navigation System (FANS): Communications Navigation Surveillance Air Traffic Management
Vincent P. Galotti, 1997

The Future of Air Traffic Control: Human Operators and Automation
National Research Council, et al, 1998

How to Prepare for the Air Traffic Control Exam (second edition)
James A. Mathews, 1997

Human Factors in Air Traffic Control
V. David Hopkin, 1995

Human Factors in Air Traffic Control
Mark W. Smolensky & Earl S. Stein (editors), 1998

Publications (continued)

International Air Band Radio Handbook: The Guide to Worldwide Air Traffic Control
David J. Smith, 1995

Journal of Air Traffic Control (quarterly magazine)
Air Traffic Control Association, Inc.

Mastering the Systems: Air Traffic Control and Weather
Richard L. Collins, 1991

The Pilot's Air Traffic Control Handbook
Tab Practical Flying Series
Paul E. Illman, 1993

Pilot/Controller Glossary
Gopher://venus.hyperk.com:2102/
(Online publication available at this Web site.)

The Pilot's Reference to ATC Procedures and Phraseology: Compiled from the Controller's Handbook 6th edition
Thomas S. Mills & Janet S. Archibald

U.S. Air Traffic Controller's Handbook (online)
http://crowe.lightspeed.net/~jason/7110/set.htm
(Online publication available at this Web site.)

Associations and Agencies

Air Traffic Control Association (ATCA)
2300 Clarendon Blvd.
Arlington, VA 22201
703-522-5717

Air Transport Association of America (ATA)
1301 Pennsylvania Ave., Suite 1100
Washington, DC 20004-1707
202-626-4000

Airline Pilots Association International (ALPA)
535 Herndon Parkway
P.O. Box 1169
Herndon, VA 22170
703-689-2270

Federal Aviation Administration
800 Independence Ave. SW
Washington, DC 20591
202-366-4000

Mike Monroney Aeronautical Center
P.O. Box 25082
Oklahoma City, OK 73125
405-954-3011

National Air Traffic Controllers Association (NATCA)
1150 17th St. NW, Suite 701
Washington, DC 20036
202-223-2900

Associations and Agencies (continued)

National Air Transportation Association (NATA)
4226 King St.
Alexandria, VA 22302
703-845-9000

National Association of Air Traffic Specialists (NAATS)
11303 Amherst Ave., Suite 4
Wheaton, MD 20902
301-933-6228

Professional Airways Systems Specialists (PASS)
1150 17th St. NW Suite 702
Washington, DC 20036
202-293-7277

Professional Women Controllers (PWC)
P.O. Box 44085
Oklahoma, OK 73144
1-800-232-9PWC