Lesson 4

LESSON PLAN

PART I

Lesson Title: Weather Elements, Part II
Instructor: Zachary
Keystone Standard: 3.1.10.A, 3.2.10.A, 3.1.10.E
See Keystone Curriculum Analysis and Linking Chart for greater detail.
Date of Lesson Development/Last Major Revision: Updated Aug 11
Visual Aids (VA): PowerPoint Presentation

Student Preparation: Read Text 1-23 to 1-28

PART IA

Lesson Objective: Know basic facts and general principles of the elements of weather.

Means of Assessment: Classroom discussion and review of lesson materials in an open classroom discussion

Samples of Behavior/Main Points:
1. Describe terrain factors that affect weather.
2. Describe types of turbulence.
3. Identify normal weather patterns.

PART IB

Strategy: This lesson uses a sequential approach building upon part one covered in lesson 3.

PowerPoint Presentation: Bulleted statements will appear on mouse clicks. Those that contain graphics or pictures will appear automatically at 1-4 second intervals after the last bullet is shown.

Lesson Outline:

Review Lesson 3 Material:
1. Clouds
2. Air masses and fronts
3. Terrain factors
4. Turbulence
5. Normal weather patterns
Lesson 4 Material
1. Terrain Factors
2. Turbulence
   a. Thermal Turbulence
   b. Mechanical Turbulence
   c. Wind Shear
3. Normal Weather Patterns
   a. Superhumid Province
   b. Humid Province
   c. Subhumid Province
   d. Semiarid Province
   e. Arid Province
   f. Hawaii and Alaska

BODY

PRESENTATION

1. Terrain Factors

   a. The presence of mountain ranges in the path of a weather front can change the characteristics of the front greatly. Gentle rolling hills also contribute to the manufacturing of weather.

   b. As air masses enter the United States, the mountains cause it to rise.

      (1) As the air rises, it cools and loses practically 100 percent of its moisture on the windward (facing the wind) slope.

      (2) The leeward slopes remain dry.

   c. Along many seacoasts, there is a breeze from the sea by day. This moist, relatively cool air rises and heats as it passes across land.

   d. Convectional clouds form a short distance inland and may bring afternoon showers.

   e. At night the land cools more rapidly than the sea, the current is reversed, and the breeze blows from land to sea.
f. Wind blowing toward land formations that slope gently upward can carry moisture-laden air to the altitude where its dew point temperature is located, and condensation will occur.

g. The reverse can happen if the wind forces clouds downward into warmer air. The clouds will again become water vapor.

2. Altimeter Concerns

a. Al altimeter is essentially a barometer measuring air density and pressure returning an altitude reading

b. Since air pressure can change, an altimeter needs to be constantly updated to the correct pressure setting. If not set correctly, an altitude error would occur based on temperature and pressure variance.

c. A significant flight safety hazard for any pilot, especially during takeoff and landing

3. Turbulence

a. Thermal turbulence—caused by intense surface heating,

(1) Intense surface heating will create columns of rising air called convection currents or thermals.

(2) More intense convection currents will be present over dark-colored ground such as a black asphalt highway.

(3) Less intense convection currents will be present over light-colored ground such as wheat fields.

(4) Because the velocity of these currents varies according to the nature of the underlying surface, turbulent conditions should be expected.

(5) Thermal turbulence presents the biggest problem for aviators during the landing portion of the flight due to the increased tendency to either overshoot or undershoot the runway.
(6) To eliminate thermal turbulence during normal flights, climb above any cumulus clouds present.

(7) Thermal turbulence is not confined to only summer months.

(8) Anytime cumulus clouds are present, convection currents exist and thermal turbulence exists.

b. Mechanical turbulence—caused by friction, the interaction of the air with another surface.

(1) Low level mechanical turbulence.

(a) Results from strong, gusty winds flowing over rough terrain or manmade features.

(b) This flow will produce turbulent eddies making flight conditions poor in the atmospheric layer below 500 feet.

(2) Wake turbulence

(a) Caused by aircraft flying through the air; disrupts the airflow.

(b) This strong, cone-shaped, rotational flow trailing behind aircraft wings is referred to as wingtip vortices and presents a major hazard to another aircraft following too closely.

(c) This condition is most hazardous during landings and takeoffs.

(3) Mountain wave turbulence

(a) Caused by wind speeds of 25 knots or stronger flowing perpendicular to a line of hills or mountains.

(b) These conditions will produce a phenomenon in which a large-scale wave
motion develops downwind from the mountain range.

(c) The turbulent effects of this wave motion can extend from ground level to the tropopause and downwind as far as 300 nautical miles.

(d) Normally, the most intense turbulence will occur within the first two or three waves.

**c. Wind Shear**—caused by a sudden change in wind direction, wind speed or both for a short distance.

1. Low level wind shear (LLWS)
   
   (a) Occurs at altitude below 10,000 feet.

   (b) Primarily caused by frontal systems, low level jetstreams, and thunderstorms.

   (c) Low level wind shear occurs quite rapidly; therefore, a pilot should anticipate turbulence and be prepared to respond when conditions are present or forecasted.

2. Clear air turbulence (CAT)
   
   (a) When turbulence occurs above 15,000 feet and is not associated with thunderstorms, it is CAT.

   (b) Not restricted to clear skies, but may also occur in a solid cloud deck.

   (c) As long as the clouds are not associated with thunderstorms, the turbulence frequently occurs in the vicinity of the upper level jetstream.

4. Normal Weather Patterns

   **a. Hawaii and Alaska**

   (1) Hawaii
Lesson 4

(a) Two major factors determine the weather in the Hawaiian Islands.

1. One is the dramatic heights and contours of the land areas.

2. The other is the prevailing northeast tradewinds that blow over cool ocean currents.

(b) These factors combine to provide typical Hawaiian weather, which is pleasant temperatures (usually in the 70’s), plenty of sunshine, and very few tropical storms.

(c) Very little distinction is seen between summer and winter except for additional rainfall in the winter.

(2) Alaska

(a) Unlike Hawaii, Alaska has several different kinds of weather, influenced by the varying terrain features.

(b) Mountains and warm ocean currents combine in the southern part of the state to make a climate with no great extremes of temperature.

1. Rainfall is heavy, but varies from one section to the next depending on local geography.

2. High mountains in the south intercept Pacific Ocean winds and wring out much of the moisture, which freezes and supports the glacier fields in the area.

3. In the Aleutian Islands, the weather ranges from cool to cold and is always rainy. Fog is also present.

(c) Beyond the mountains in the northern section of Alaska lies the Arctic slope,
an area exposed to winds from the Arctic Ocean.

1. Temperatures are relatively mild in midsummer and early autumn.

2. Ice stops shipping movements for up to 10 months of the year.

(d) Between the oceanic area of the south and the arctic area of the north lies a large area of broad valley and low mountain ranges.

1. The interior section has continental weather comparable to the Great Plains of the western United States.

2. Temperatures can drop to –70\(^\circ\) F in the winter and can climb to 90\(^\circ\) F during the long sunlight hours of the summer.

CONCLUSION

SUMMARY
In this lesson we discussed:
1. Terrain Factors
2. Turbulence
3. Normal Weather Patterns