CORE SUBJECTS: EARTH SCIENCE, ATMOSPHERIC SCIENCE

FROM THE MOMENT YOU JUMP into a pool or lake or the ocean you have entered the water; whatever qualities the water possesses affect you directly. If the water is cold, you shiver. If the waves are high, you ride their crests and troughs. The current, if any, pulls you as you swim.

When pilots launch their airplanes into the sky, they too become inextricably connected to the "ocean" of air around them. So pilots must study the ways weather distributes the cold and heat, forms the wind, and creates the precipitation we experience on the ground as rain, snow, and sleet.

Students have been affected by changes in weather patterns since they were little and their parents either lathered them with extra sunscreen on a sunny day or bundled them up with an extra sweater during a snowstorm. Teaching weather, its causes and effects, does not have to be a theoretical lesson of one invisible air mass hitting another invisible air mass. Place an airplane in the middle of your lesson and let students determine what impact the weather systems would have on the path of that airplane. Would they want to fly today—or tomorrow—through the path of an oncoming thunderstorm? Or would a small airplane get bounced around too much in wind gusts and heavy rain?

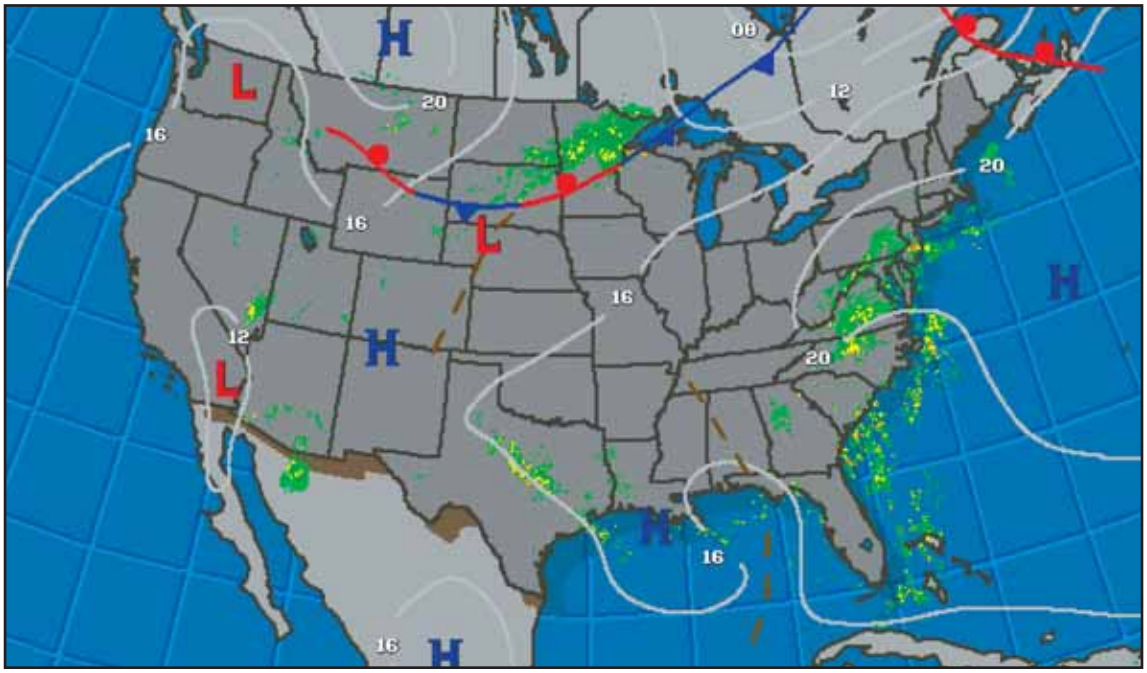
What is weather? The sun heats the earth unevenly, creating *air masses* (or regions of air) of varying density, and causing air to circulate over the globe. This heating, along with other factors, also develops areas of relatively high and low pressure. Air tends to flow from areas of high pressure to areas of low pressure, which we experience as wind.

DEFINITION

Frictional Force: The surface of the Earth exerts a frictional drag on the air blowing just above it. How much friction changes with differences in terrain and whether or not the wind blowing has to slow down or change direction to move up, down and around any trees, mountains, etc.

High or low pressure is typically depicted on weather maps as H's and L's. Generally, good weather is associated with highs, while poor weather is often found in the lows. If you watch the weather forecasts on television or download weather maps from the Internet you can compare where the H's and L's are positioned to where the rain or snow is falling—and often make a connection.

Wind causes air masses to move, and they encounter other air masses that have different characteristics. The boundary between



two air masses is called a *front*. Weather along fronts may be hazardous to pilots because of the clouds, precipitation, and turbulent air (*turbulence*) that it can produce. A *cold front* is where a cold air mass displaces warmer air. A *warm front* is where warm air displaces colder air. *Stationary fronts* have no movement.

DEFINITION

Windshear: A quick change in the speed and/or direction of wind.

Temperature, wind, and ambient air pressure change as a front passes by.

Pilots watch the areas of high and low pressure and the movement of fronts to determine what the weather will be like for an upcoming flight. In particular, they look at the clouds, precipitation, wind, and convective activity associated with the weather patterns to make the decision to fly or not.

You know convective activity if you've ever witnessed a thunderstorm. Heating of the earth's surface also causes clouds to build if enough moisture is present in the air. When conditions are ripe, clouds tower into *thunderstorms*, sending heavy rain, hail, strong gusty winds, and sometimes tornadoes, into the area covered by the storm. Thunderstorms are dangerous for airplanes because they combine a number of hazards into one area.

Precipitation, in the form of rain, snow or sleet, can determine whether or not a pilot is able to proceed. Heavy rain can reduce visibility. Snow can block engine air intakes, affecting the engine performance. water droplets adhere to the airplane in the form of ice, changing both the weight and the shape of the wings and other components, decreasing the airplane's ability to produce lift. Wind affects the airplane's speed over the ground, and also may create turbulence or wind shear. Turbulence caused by gusty winds can range from uncomfortable bumps to severe jolts that render the airplane uncontrollable.

ACTIVITY: Reading weather maps

Photocopy this activity for classroom use.
Go to www.aopa.org/path for student worksheets.

TEACHERS:

From this activity, students will learn how to glean the basics from weather forecasts and try to predict how the weather will change in the near future.

MATERIALS:

Weather charts for a five-day period.

Current surface analysis charts and forecasts can be found at http://adds.aviationweather.gov/progs or go to www.intellicast.com and click on "Curent Surface Analysis" for current conditions of click on the " US Weather" tab and "Surface Analysis" for more options.

Other free sites include the National Weather Service at www. nws.noaa.gov of the Weather Channel at www.weather.com

TO DO IT:

Meteorologists use complex models involving physics and mathematics to predict the weather. But they also consult weather maps that are available to you to make a rough estimate of what the future weather holds. They often look at surface analysis charts, which show the conditions at a given time. By looking at several days' worth of maps, you can look at how the weather has moved from one place to another, how it appears to build or dissipate, and how that weather may have affected pilots flying in that region. You also can take a guess at what the weather will bring to you in the next few days.

- Print out the surface analysis charts (or current conditions maps) for five days in a row from the web sites listed above.
- On the first chart, identify the areas of high and low pressure, and the fronts depicted on the chart. Cold fronts are in blue, and marked with triangles; warm fronts are in red, and marked with half circles.
- Where are the areas of precipitation associated with each front? Each low?
- Now do the same for the next four days' worth of charts. How are the fronts moving? What happens to the highs and lows as they move?
- Wind tends to parallel a frontal boundary ahead of the front, and pushes from behind a front once the front passes. Can you mark on the chart the direction you think the wind is blowing in each case? Is the wind too strong for a small airplane to fly?
- Spot your city or town on the chart. What has the weather been like in your area during the days for which you have charts? How does that weather correlate with the highs and lows and fronts you see on the chart?
- Based on the charts, what would you expect the weather to be like tomorrow? Test your forecast by writing it down and comparing it to tomorrow's actual weather.