

# Weather 101

## Fundamental Meteorology for Turf Managers

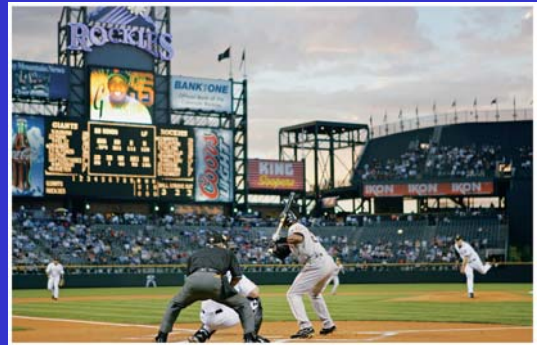
Brad Jakubowski  
Doane College



Photo by Beyer Weckerle



## Do Baseballs Really Fly Farther at Coors Field?



## Learning Objectives

- Water
- Temperature
- Pressure
- Fronts
- Forecasting
- Lightning and Safety

## Water

- One of the Earth's greatest power sources
- One of the Earth's biggest recycling programs
  - 91,000 cubic miles is recycled every year
  - Great Lakes = 5500
  - Earth averages 41 inches rain per year



## Water's Changes of State



Ice melting absorbs heat



Evaporation absorbs heat  
Anyone syringe their turf?



© Olivier Vandeginste 2005  
**Condensation releases heat**



## Water's Changes of State

Freezing releases heat

## HUMIDITY

### Water in the Atmosphere

**Absolute Humidity:**

- The actual amount of water vapor in the air at a given time.

**Water Vapor Capacity:**  
 (also called Saturation Mixing Ratio)

- Maximum amount of water vapor that air can hold at a given temperature.

**TABLE 4-1** Saturation mixing ratio (at sea-level pressure)

Temperature °C (°F)	Saturation mixing ratio g/kg
-40 (-40)	0.1
-30 (-22)	0.3
-20 (-4)	0.75
-10 (14)	2
0 (32)	3.5
5 (41)	5
10 (50)	7
15 (59)	10
20 (68)	14
25 (77)	20
30 (86)	26.5
35 (95)	35
40 (104)	47

### Relative Humidity:

- A percentage of the actual amount of water compared to amount air can hold at a given temperature
- Indicates how near air is to saturation NOT actual amount of air in the air

**10° C**

100 %  
Relative Humidity

**20° C**

52 %  
Relative Humidity

**30° C**

28 %  
Relative Humidity

Which situation has more moisture in the air?

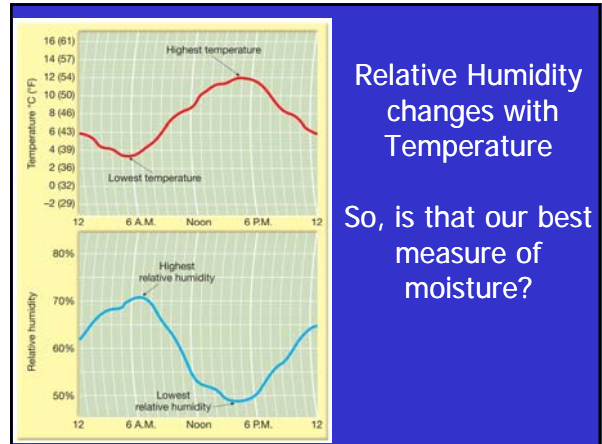
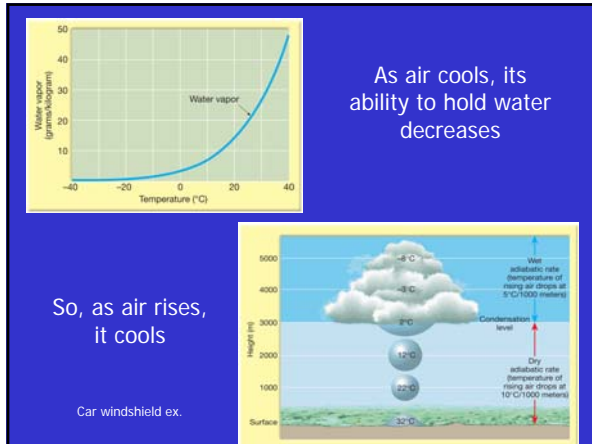
32°F can hold 3.5g/kg

104°F can hold 47g/kg

$10\% * 47 = 4.7g/kg$

**100% R.H. @ 32°F (0°C)**

**10% R.H. @ 104°F (40°C)**



### Dew Point or Dew Point Temperature

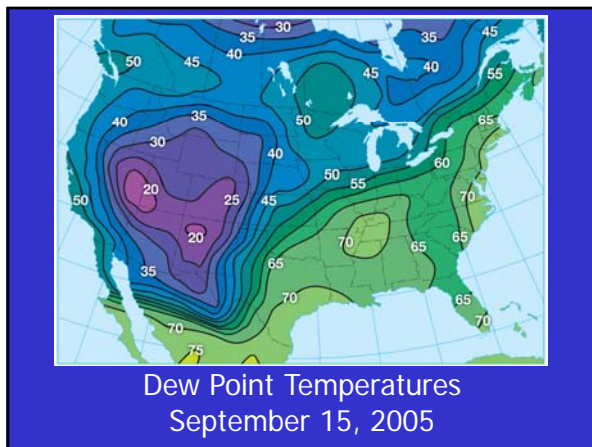
- The temperature at which condensation occurs
  - When air is cooled to the dewpoint condensation occurs
  - Grass, glass, etc.
- Better indicator of how moist the air is

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**TABLE 4-2 Dew-point thresholds**

Dew-point temperature	
≤ 10°F	Significant snowfall is inhibited.
≥ 55°F	Minimum for severe thunderstorms to form.
≥ 65°F	Considered humid by most people.
≥ 70°F	Typical of the rainy tropics.
≥ 75°F	Considered oppressive by most.

So:  
 High dew point temps = moist air  
 Low dew point temps = dry air



### Temperature

23½° N

60°

66½°

30°

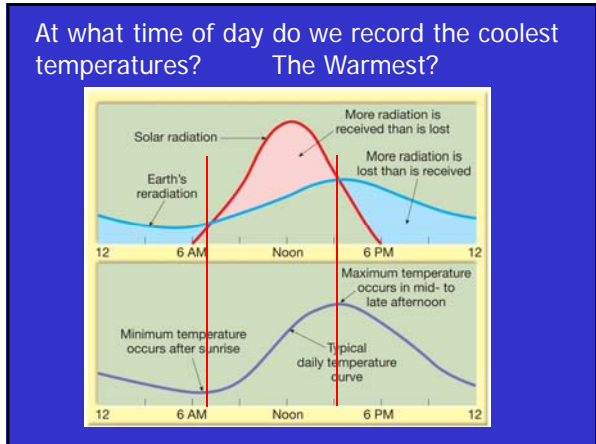
0°

23½° S

Atmosphere

Sun's rays

- The Earth receives the sun's energy unevenly
- Energy is:
  - Absorbed
  - Reradiated
  - Transferred



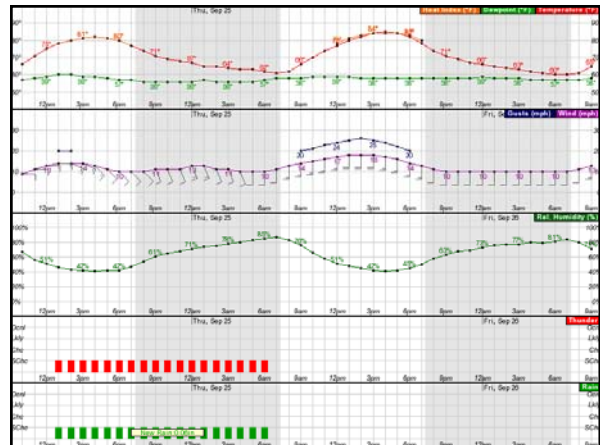
Minimum daily temperature occurs near sunrise, causing early morning...  
 ...Winter Frost  
 ... or Summer Fog  
 ...the air was cooled to the dew point

How can understanding dewpoint and temperature benefit turf managers?

**Predicting Frost or Dew**

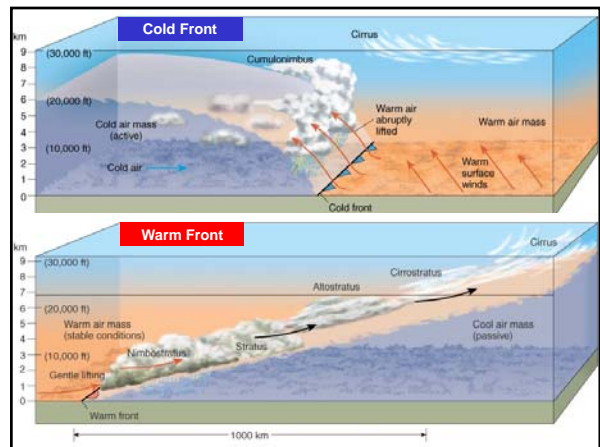
- Scheduling
  - Maintenance (minimize labor downtime)
  - Early morning ball games or practices
- Planning pesticide applications
  - Fungicides, weed and feeds, etc.

Calibrate sunrise, sunset, temperature and dewpoint forecasts with actual results



**Fronts**

- Narrow boundary zones separating relatively warm and cold air



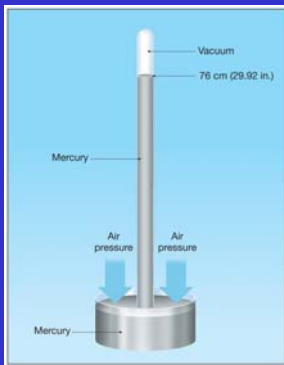
### Warm Front Precipitation (~2-3 day window)



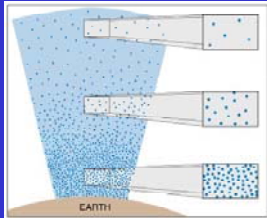
### Thunderstorm Development along a Cold Front (window of hours to days)



### Pressure

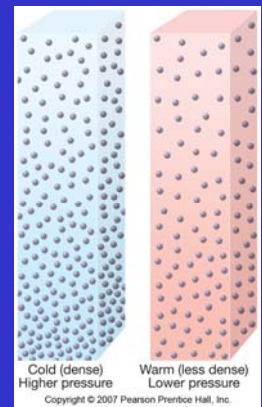


- Total weight of the atmosphere



### Pressure Changes with Temperature

- High Pressure  
– Stable Air
- Low Pressure  
– Unstable Air



### Associated Weather...

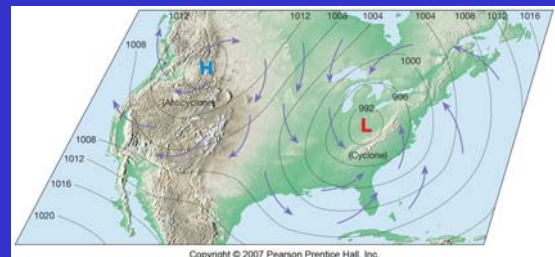


...with  
Low Pressure  
(rising air)

...with  
High Pressure  
(descending air)

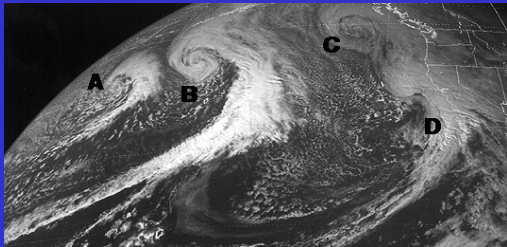


### Surface High and Low Pressure Systems



# Mid-Latitude Cyclones

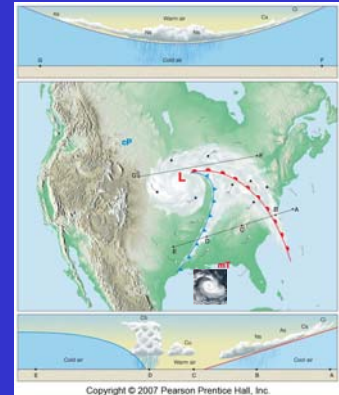
- Key for the Earth's Transfer of Energy
  - Earth's Eggbeater
  - Continental in size



# Mid-Latitude Cyclones

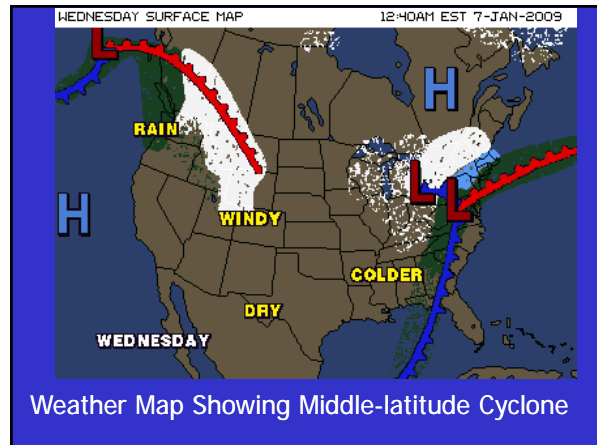
Follow general patterns

- Travel West to East
- Exhibit similar weather conditions
  - Wind
  - Clouds
  - Precipitation



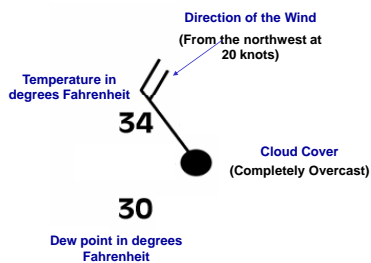
# Forecasting Weather

- Traditional methods match established patterns from patterns of the past
  - Utilizes "rules of thumb"
- Computers play key role in accuracy and lengthening the lead time of forecasts
  - Many models are put into use
- Human approach is still needed
  - Still requires a 'feel' to make it all work



Weather Map Showing Middle-latitude Cyclone

# Let's review the station model



**The WeatherCycler**  
For Interpreting and Forecasting Your Weather

The Weather School  
www.weathercycler.com

**INSTRUCTIONS:**  
Circle the label (station or newspaper weather map) and put the side (A or B) points to the station label showing your location in the HIGH or LOW affecting your weather. The Surface Weather Map and the windsock shows it describe your weather if Point A indicates your location in the HIGH or LOW. Use the windsock below if Point B indicates your position.

To forecast your weather, pull the slide out slowly to represent movement of HIGH or LOW. Your changing map location shows how your weather will develop. The next plotted position shows what your weather may be in about 12 hours. Check your forecasts by following the instructions on back.

**COMMON WEATHER MAP SYMBOLS**

**WINDS** give you the DIRECTION and SPEED of the wind. The arrow shows the direction and the number shows the speed.

**SHADED AREAS** show the amount of cloud cover.

**WEATHER SYMBOLS** indicate direction (top) which wind is blowing. Decreases when (SPRINK) Rainfall or (SNOW) 1" - 3.0 inches. Amount of Cloud Cover. (S) - Scattered Clouds. (C) - Completely Overcast. (D) - Partly Cloudy. (F) - Partly Sunny. (B) - Partly B. (N) - Partly N. (S) - Partly S. (W) - Partly W. (E) - Partly E. (SE) - Partly SE. (SW) - Partly SW. (NE) - Partly NE. (NW) - Partly NW. (E) - Partly E. (W) - Partly W. (S) - Partly S. (N) - Partly N. (SE) - Partly SE. (SW) - Partly SW. (NE) - Partly NE. (NW) - Partly NW.

**FOOTNOTES:** Use the surface weather map to forecast (PREF) temperature and wind weather changes. Your arrow from the surface weather map and in the wind direction of changes. (PREF) temperature and wind weather changes.

**Weather at A**  
Side View of Atmosphere  
Air Pressure and Temperature Changes

**Weather at B**  
Side View of Atmosphere  
Air Pressure and Temperature Changes

# The WeatherCycler

**Check Your Forecast**

**YOUR WEATHER:**

The weather now at some place to the west of you is likely to be your weather tomorrow. This is because the major weather makers, HIGHS and LOWS, usually travel from west to east. This WeatherCycler is based on the common characteristics and motions of HIGHS and LOWS. It can help you understand your weather and the latest forecasts. You can also use it to make your own general forecasts.

"H's" on maps point to the high-pressure centers of broad masses of relatively uniform air in which weather varies gradually from place to place. These air masses can be warm or cold, depending on where they were formed. The weather in HIGHS is typically fair. Winds blow clockwise around the centers of HIGHS.

"L's" mark the centers of low-pressure areas that form along the boundaries dividing neighboring and contrasting air masses. They have warm and cold air sectors which are seen separated on maps by boundaries called fronts. Most of our rapid weather changes and storms are associated with LOWS. Winds blow counterclockwise around the low-pressure centers.

While HIGHS and LOWS may shift north or south in their travels, their major motion is from west to east. Since HIGHS and LOWS visit our locations one after another, we experience cycles of fair and stormy weather.

**INSTRUCTIONS:**

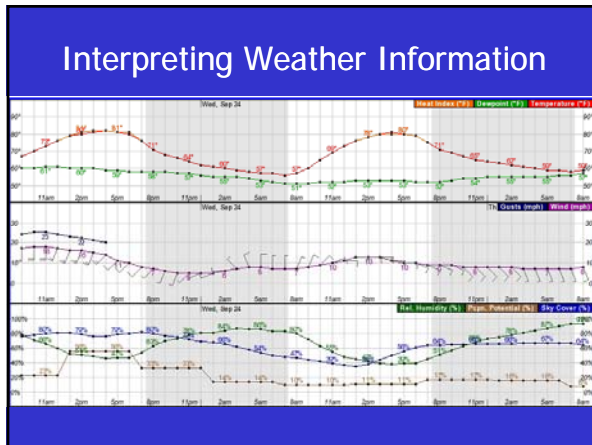
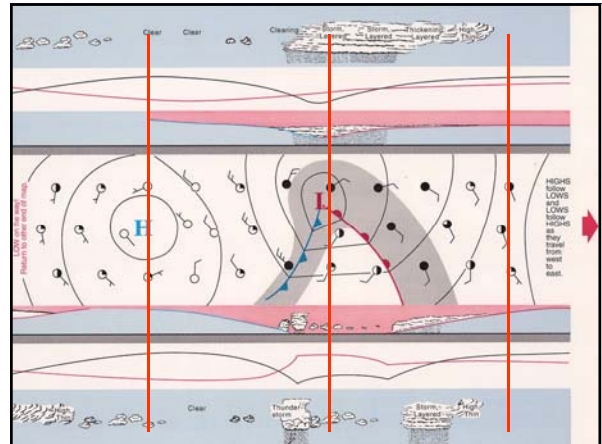
On front side, pull slide to set Surface Weather Map to current conditions. Taking into account displayed weather information, forecast the weather for the next half day or so. Without moving slide, flip back to this side and look in the appropriate window to check forecast.

**Forecast at Station A**

Increasing clouds  
winds from southwest  
slight change in temperature

**Forecast at Station B**

Increasing clouds  
winds from southwest  
slight change in temperature



## Thunderstorm and Lightning Safety

- No place outside is safe near a thunderstorm
- Lightning can strike long distances, even outside of rain and cloud cover
- 45% of lightning casualties occurred on open fields (includes Sports Fields)
- Obey the 30/30 rule
  - Get Indoors
  - If thunder occurs 30 seconds or less after lightning
  - Wait 30 minutes after the last thunder




**If You Can Hear Thunder, Seek Shelter!**

- Avoid Wide Open Areas
  - Sports Fields
  - Playgrounds
  - Parking Lots
  - Beaches
  - Others







## Weather Resources

Free Websites

Current weather:  
<http://weather.gov> (National Weather Service)  
<http://weather.com> (The Weather Channel)  
<http://www.crh.noaa.gov/oax>  
<http://www.spc.noaa.gov/>  
<http://www.rap.ucar.edu/weather>

Professional Weather Services:  
 Customized Online Access, Lightning Monitors, Alerts,  
 Online Consulting, Mobile Access  
 DTN Meteorlogix [www.dtnmeteorlogix.com](http://www.dtnmeteorlogix.com)  
 Custom Weather [www.myforecast.com](http://www.myforecast.com)

