

Topic 1 – The Atmosphere and Atmospheric Variables

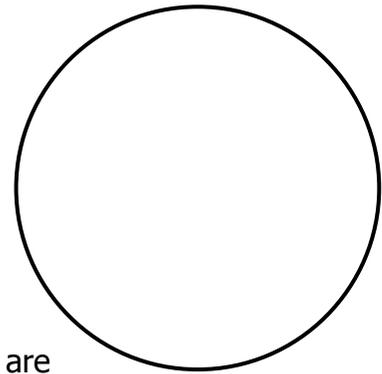
What is the atmosphere? _____

Meteorology is the study of _____

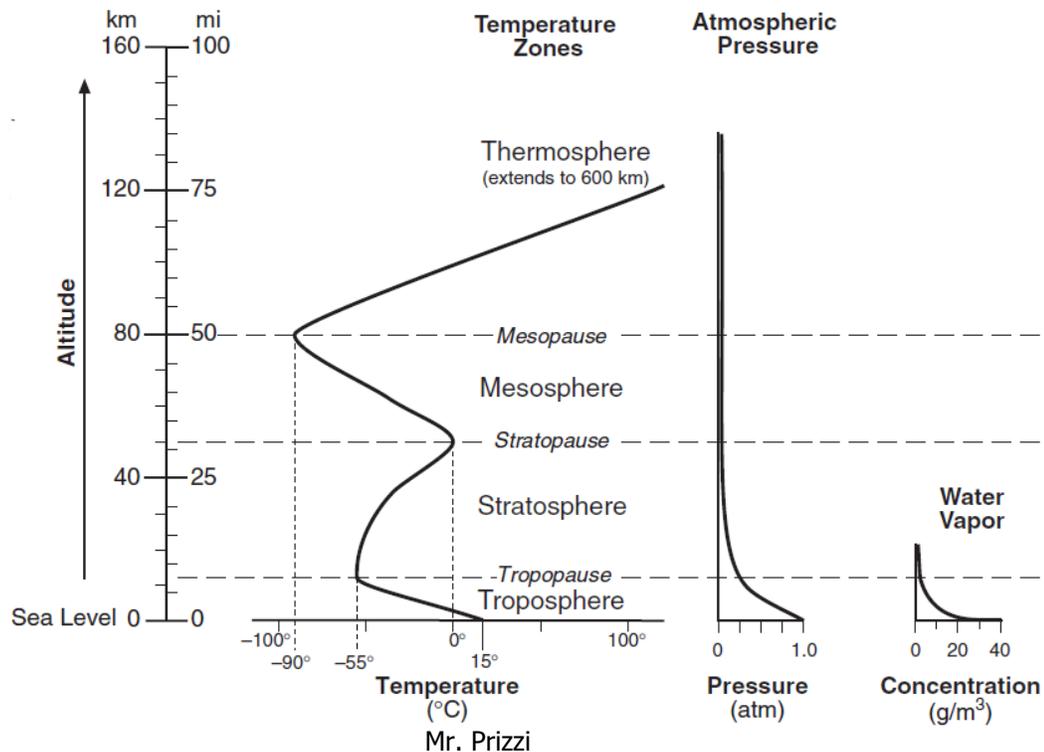
A. Structure of the Atmosphere:

What two gases account for 99% of Earth's Atmosphere?

If the circle represents the Earth, how thick would the atmosphere be in comparison?



The atmosphere consists of _____ **distinct layers**, which are separated by diffuse interfaces that end in the suffix **-pause**. Be familiar with pages 14, 13, & 11 in the ESRT.



How do we describe the present condition of the Atmosphere?

Atmospheric Variables:

B. Temperature:

1. There are three scales that measure temperature: Celsius, Fahrenheit and Kelvin. See your **ESRT page 13** for the _____ scale.

<i>Fahrenheit</i>	<i>Celsius</i>	<i>Kelvin</i>
	0	
90		
		253
	14	

2. Solar radiation, which is _____, heats Earth's surface. Then heat energy, which is mainly _____, is given off to space. Certain gases which are called _____ absorb much of this energy and are causing the Earth's temperature to increase. This is called the Greenhouse effect and in the media it's called _____ or _____.

The main greenhouse gases are _____.

Use this space to draw how energy is trapped during the Greenhouse Effect.



3. Isotherms – Meteorologist find it useful to map temperatures and they use a type of isoline called an isotherm. Isotherms connect locations of equal temperature.

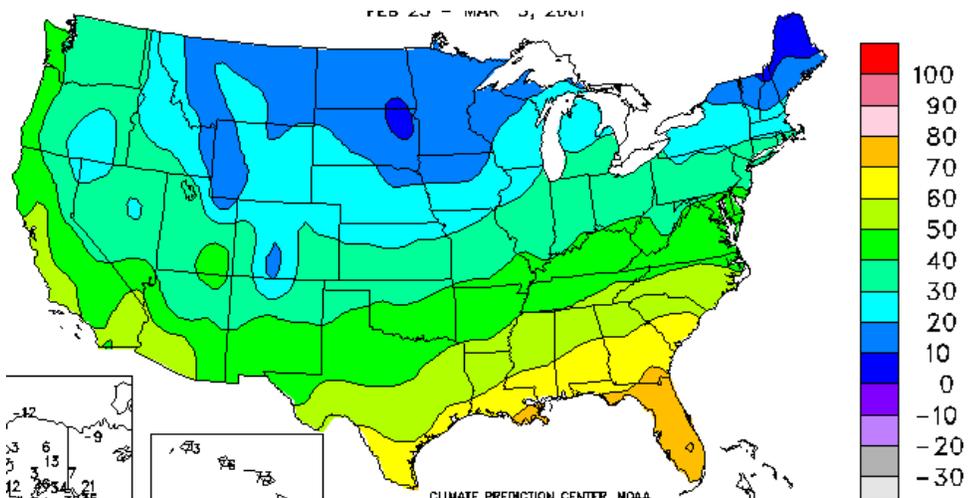
Here is an example:

What is the temperature in Northern NY? _____

Florida? _____

Maine? _____

As latitude increases, average temperatures will _____.



Name _____

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Draw isotherms below at 10° intervals starting at 50°F.

85 • 80 • 70 • 60 • 50 • 45 •

90 • 82 • 70 • 57 • 50 •
 86 • 80 • 60 •

95 • 90 • 75 • 69 • 58 •

C. Air Pressure – is also called _____ pressure or _____ pressure. Air pressure is defined as the weight of the atmosphere pushing down on us. A column of air from the top of the atmosphere to sea level weighs 14.7 pounds per square inch.

1. A **barometer** is the instrument that measures air pressure and the units are either millibars (mb) or inches of mercury. See the ESRT page 13 for a conversion scale.

In millibars (mb), what does 30.15 inches of Mercury equal? _____

In inches of Mercury, what does 1001 mb equal? _____

What factors affect air pressure? Air pressure changes frequently depending on temperature and/or humidity.

- a. **Temperature** - As air temperature _____, air pressure decreases. This is an _____ relationship.
- b. **Humidity** - As humidity in the air _____, air pressure decreases. This is an _____ relationship.

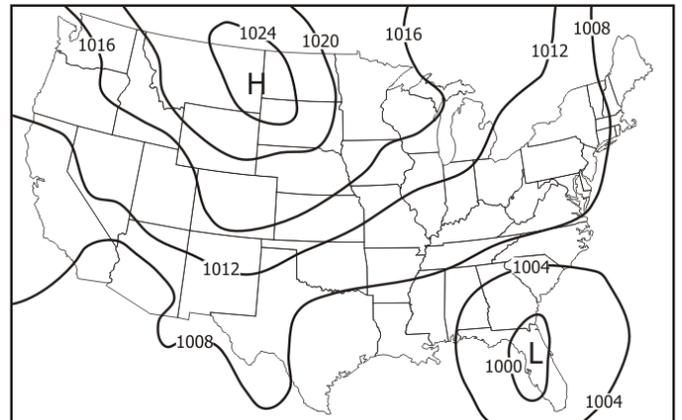
WHY?

Humid air is lighter than dry air. When water vapor molecules enter dry air, it does not squeeze between the molecules of air. Actually, the water vapor pushes out many of the air molecules like Oxygen and Nitrogen. Water vapor molecules have less mass than air molecules so the **moist air weighs less than the dry air** and therefore exerts less pressure on us.

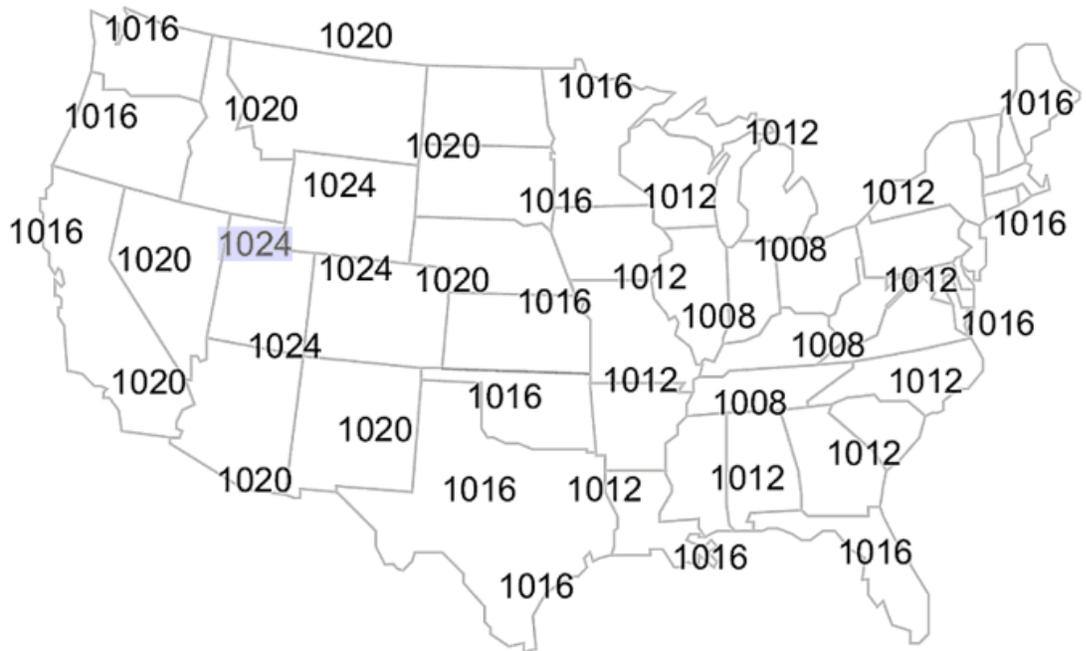


What kind of weather does a decreasing air pressure indicate?

- **Isobars** - Meteorologist find it useful to map air pressure and they use a type of isoline called an isobar, which connects locations of equal pressure.



On this map, draw isobars at an interval of 4 mb starting at 1008.



D. Wind – Wind is the horizontal movement of air. Winds are named for the direction from which they come. An _____ measures wind speed and a wind vane measures _____.

What is the name of wind that blows from Florida toward NY?

1. What causes wind?

The Earth's surface heats up _____. When areas of the Earth's surface get hot, they in turn heat the air above them. As you already know, changing the temperature of the air changes its _____. Winds **always** blow from areas of _____ pressure to areas of _____ pressure.

So, ***the uneven heating of the Earth's surface causes air pressure differences and air pressure differences cause wind.***

"High to Low are the way winds blow" (J. Prizzi)

On the map above, draw ONE arrow to show what general direction the wind will blow.

2. What causes some wind to be faster?

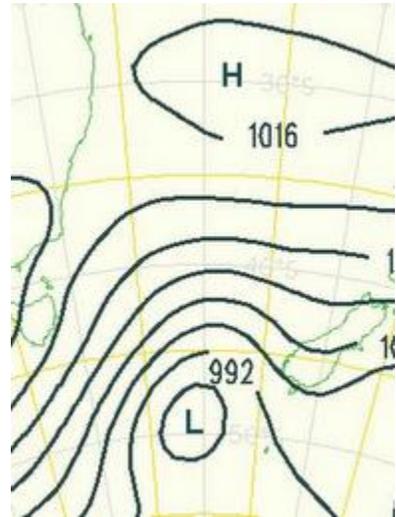
A. Wind velocity (or speed) is greatest when there is a greater difference in _____ between two regions. This is called **pressure gradient**. A **steep pressure gradient** means there is a large pressure difference between two locations.

Example to help your understanding: *Imagine two bicycle tires; one nearly flat and the other fully inflated.*

Name _____

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B. Wind speed and isobars: Where isobars are closer together, the wind will be faster. ***Why do you think this is true?*** On the map to the right, mark with an "X" where you think wind speed would be greatest.



Do winds blow straight from areas of High pressure to areas of Low pressure?

No, winds DO NOT blow straight, they curve to the right in the Northern Hemisphere. Why? It's called the coriolis effect.

3. The Coriolis Effect is caused by the _____ of the Earth and causes free flowing objects to curve to the _____ of their path in the Northern Hemisphere. This causes **winds & water currents** to curve to the **right of their paths**.

Where you drew isobars, lightly draw wind directions with arrows. Remember the Coriolis effect!

Local Breezes, which are small-scale movements of air.

There are two types:

a. Sea Breezes – During the day along coastal areas, the land will heat up faster than the water. The air **over the land** will become warmer causing it to be less dense, which results in a **Low-pressure area**. At the same time, the air over the body of water remains cool and more dense, which results in an area of **HIGH pressure**. The difference in air pressure creates a small-scale wind called a sea breeze that blows from high to low pressure. ** A sea breeze is also known as an **on-shore breeze**.



b. Land Breezes – At night, the land cools down faster than the water (due to land's lower specific heat). This causes the air above the land to become cooler than the air above the water. This causes the air to be more dense, which creates an area of high pressure over the land. The air above the water is warmer and less dense, which creates an area of low pressure above the water. This difference in air pressure creates a breeze from the land to the sea.



More about Wind... See ESRT page 4 & 14

Prevailing winds and ocean currents – Wind is the major factor that causes ocean currents. Both prevailing (AKA planetary) winds and ocean currents are affected by the Coriolis Effect.

Convection cells – Convection is the movement of a gas or liquid caused by differences in density. Large-scale convection cells occur in the atmosphere, which cause the prevailing winds.

Zones of diverging and converging air result from the convection cells in the atmosphere, which cause dry or wet areas.



How is specific heat involved in the formation of winds?

E. Humidity – (AKA moisture, water vapor) The amount of water vapor in the air is always changing. When the air is _____, that means it is holding as much humidity as it can and relative humidity = 100%.

Warm air can “hold” _____ humidity and cooler air can “hold” _____.

KEY TERMS:

1. **Dew Point temperature** is the temperature at which air becomes saturated and if the temperature falls below this temperature **condensation** occurs.
2. **Condensation** is the process of water vapor turning into water droplets.
3. **Relative humidity** shows how much water vapor air is holding at a certain temperature compared to how much it could hold. It is expressed as a percentage.

Measuring Humidity - A psychrometer (AKA sling psychrometer) is an instrument used to measure humidity. Using this instrument and the two charts on page 12 of the ESRT, we can calculate the Dew Point Temperature and Relative Humidity of air.

How to calculate Dew Point Temp. and Relative Humidity in ESRT:



- 1st) Subtract the wet-bulb temperature from the dry-bulb temperature. This is called the wet-bulb depression or difference.
- 2nd) Locate the wet-bulb depression along the top of the chart and locate the dry-bulb temperature along the side of the chart.
- 3rd) Where these two numbers intersect on the chart is the value of either the dew point temperature or relative humidity.

Calculate dew point temperature and relative humidity with the following values:

dry-bulb temperature = 8°C

wet-bulb temperature = 3°C

Difference (wet-bulb depression) = _____

dew point temperature = _____ °C

relative humidity = _____ %

Name _____

Regents Earth Science

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Try these examples:

1. dry-bulb temperature = 12°C
wet-bulb temperature = 5°C
difference = _____
dew point temperature = _____ °C
relative humidity = _____ %

2. dry-bulb temperature = 22°C
wet-bulb temperature = 20°C
difference = _____
dew point temperature = _____ °C
relative humidity = _____ %

F. Clouds and Precipitation

1. Condensation is the process by which a gas turns into a liquid. This is the process that forms _____.

For condensation to occur, two things must be present or happen:

1st. The temperature of the air mass must reach its dew point temperature,

AND

2nd. A surface must be present for the water vapor to condense upon. This surface can be dust, pollution, or volcanic ash in the atmosphere. On the surface of Earth it can be a car, lawn or a flower. All of these are called **condensation nuclei**.



How could the following things be condensation nuclei?

Cold glass of soda:

Car in morning:

2. Cloud Formation - A cloud is a mass of air that has suspended **droplets** of _____ in it. In order for a cloud to form, a few events must occur.

1st Air must _____.

2nd The air will _____ due to less air pressure above, which causes the air temperature to _____.

3rd _____ will occur if the temperature decreases to the dew point temperature and if there is condensation nuclei available.

Finally, a cloud is created!

2. Precipitation – Any falling liquid or solid water from clouds is considered precipitation.

List all the ways air can be forced to rise.



- a) **Coalescing** – This is the process by which tiny water droplets in clouds “knock” into one another and grow into larger water droplets. The water droplets will fall to ground when they become too large to be suspended.

G. Weather Forecasting:

1. Observation Instruments:



List the information that each instrument is used to collect and the units used.

Thermometer

Barometer

Anemometer

Wind Vane

Sling Psychrometer

2. Weather indicators (or relationships):

- A **decreasing** barometer (air pressure) means precipitation is **more likely** and an **increasing** barometer means precipitation is **less likely**.
- As air temperature and dew point temperature get **closer together**, relative humidity **increases** and chance of precipitation **increases**.
- Storm tracking** – In the US, weather moves from **west to east** and when it gets closer to the east coast it moves **northeast**. If you look at a map and Chicago has good weather then NY will probably have similar weather the next day.

Close spacing of isobars on a weather map is a good indicator of

- (1) low visibility
- (2) low dewpoint temperatures
- (3) high air temperatures
- (4) high wind velocity

15 _

The moon lacks an atmosphere. Of the following statements, which is correct?

- (1) Air pressure would still exist since the moon has gravity.
- (2) Air pressure would still exist since the Earth's atmosphere extends to the moon.
- (3) Air pressure would not exist on the moon.
- (4) Air pressure on the moon equals the Earth's air pressure.

9 _____

A parcel of air has a dry-bulb temperature of 18°C and a wet-bulb temperature of 10°C. What are the dewpoint and the relative humidity?

- (1) 5°C and 19%
- (2) -5°C and 19%
- (3) 2°C and 33%
- (4) -2°C and 33%

3 _____

What is the relative humidity when the air temperature is 29°C and the wet-bulb temperature is 23°C?

- (1) 6%
- (2) 20%
- (3) 54%
- (4) 60%

2

When you see a cloud are you seeing water vapor, or water droplets?

What is the relative humidity within a fog?