

Climatology

Texts:	<p><u>The Atmosphere</u> 10th edition by Lutgens and Tarbuck, Pearson Prentice Hall, 2008.</p> <p><u>Earth Science</u> by Tarbuck and Lutgens, Pearson Prentice Hall, 2009.</p>
Supplemental Materials:	Handouts, articles, and videos provided by instructor during the semester
Course Description:	<p>Climatology is a one semester course (1/2 Unit) offered to juniors and seniors who wish to learn the scientific aspects of climate, including the impact of human activities on our climate system regionally and globally. Students will be able to describe the composition and structure of the atmosphere; understand the distribution and movement of air, circulation patterns, air masses and weather fronts; discuss the dynamic interactions of the atmosphere, oceans, cryosphere and land including mid-latitude cyclones, lightning, thunder, tornadoes, tropical storms and hurricanes; debate human activities associated with ozone depletion, urban heat islands and global warming; explain the patterns of Earth's climates and how those patterns change over time.</p>
Methods of Evaluation:	Evaluation is based primarily by tests, labs, vocabulary quizzes, projects, class work and homework assignments.
Pace of Instruction:	<p>Unit 1-Earth and Its Atmosphere</p> <p>Unit 2-Atmospheric Stability and Clouds</p> <p>Unit 3-Air Pressure, Winds and Atmospheric Circulation</p> <p>Unit 4-Weather Patterns and Severe Weather</p> <p>Unit 5-World Climate and Climate Change</p> <p>Exam-Cumulative Final Exam</p>
Unit Objectives:	<p>At the end of the course, the students should be able to:</p> <p><u>Unit 1-Earth and Its Atmosphere</u></p> <ul style="list-style-type: none"> • Distinguish between weather and climate. • List the basic elements of weather and climate. • List and briefly describe the four major “spheres” that make up the natural environment. • Discuss the importance of the following atmospheric components: carbon dioxide, water vapor, ozone, and aerosols, and describe the principal gases of dry air. • Summarize the cause and possible effects of stratospheric ozone depletion, and discuss international efforts to reduce it. • List at least four different methods of exploring the atmosphere. • Sketch, label, and explain a graph showing the thermal structure of the atmosphere.

<p>Unit Objectives:</p>	<ul style="list-style-type: none"> • Describe the vertical changes in air pressure and atmospheric composition from Earth’s surface to a height of several hundred kilometers. • Describe the nature and extent of the ionosphere and the electrical phenomena that take place there. • Describe the basic motions of Earth (rotation and revolution). • Discuss the causes for seasons. • List the basic characteristics of the solstices and equinoxes and the corresponding dates. • Calculate the angle of incidence, latitude of vertical sun and latitude of location mathematically. • Contrast the concepts of heat and temperature. • Distinguish among the three basic mechanisms of energy transfer. • Distinguish among scattering, reflection, and absorption of solar energy and discuss where each of these occurs in the Earth–Atmosphere system. • Explain how Earth’s atmosphere is “heated from the ground up” and why this happens, including an understanding of the greenhouse effect. • Define heat budget and discuss the importance of radiation balance in this matter on a local and global scale. <p><u>Unit 2-Atmospheric Stability and Clouds</u></p> <ul style="list-style-type: none"> • Describe the movement of water through the hydrologic cycle. • Summarize the processes by which water changes from one state to another, and know what happens to latent heat during each change. • Distinguish among absolute humidity, mixing ratio, vapor pressure, relative humidity, dew point temperature, and saturation vapor pressure. Also, know which of these variables are temperature-dependent and state the relationship between temperature and each of them. • Identify the two ways in which relative humidity can be changed and list three major ways in which air temperatures change in nature. • Understand the importance of dew point temperature and how it is different from relative humidity. • Describe adiabatic temperature changes and differentiate between the dry adiabatic rate and the wet adiabatic rate. • Describe the four mechanisms that cause air to rise. • Discuss the role of condensation nuclei in the formation of clouds. • Discuss the basis for the classification of clouds. • Identify major cloud types on the basis of their form and height.
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<p>Unit Objectives:</p>	<ul style="list-style-type: none"> • Understand how and why dew, frost and fog form. • Distinguish among rain, snow, sleet, glaze and hail and describe the circumstances under which each of them forms. • Discuss the three categories that intentional weather modification fall into and identify some applications that employ intentional weather modification using modern weather technology. <p><u>Unit 3-Air Pressure, Winds and Atmospheric Circulation</u></p> <ul style="list-style-type: none"> • Discuss how a mercury barometer and an aneroid barometer measure air pressure. • Describe the “normal” decrease in pressure experienced with increased altitude. • List the three factors that control wind and briefly describe each. • Write a generalization relating the spacing of isobars to the speed of wind. • Describe the relationship between hydrostatic equilibrium and gravity. • Explain what geostrophic winds are and describe their behavior. • Discuss cyclones and anticyclones. • Discuss the relationship between pressure tendency and forthcoming weather. • List the instruments used to measure wind speed and wind direction. • Distinguish among macro, meso and microscale atmospheric motions. • Describe the idealized pattern of global circulation as proposed by George Hadley. • Sketch and label a diagram showing the idealized three-cell model of global circulation. • Discuss how the locations of continents and oceans influence the global pressure distribution. • Discuss what monsoon and jet streams are. • Describe the relationship between oceanic circulation and general atmospheric circulation. • Describe the relationship between El Niño and La Niña. • Describe and explain how global precipitation distribution is related to global winds and global pressure systems. • Describe precipitation patterns on a uniform Earth and compare those patterns with actual patterns that exist on Earth. <p><u>Unit 4-Weather Patterns and Severe Weather</u></p> <ul style="list-style-type: none"> • Describe what an air mass is and discuss the classification of air masses.
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Unit
Objectives:

- Describe the ways that air masses are modified.
- Discuss the weather conditions associated with cP, mP, mT, and cT air masses that influence North America.
- Recognize midlatitude cyclones as the primary weather producers in the middle latitudes and describe their size, movement, duration, circulation and fronts associated with them.
- Compare and contrast warm fronts and cold fronts in terms of their structure and associated weather.
- Describe stationary fronts, occluded fronts and drylines.
- Outline and explain the stages in the life cycle of a wave cyclone.
- Describe the changes in wind direction, pressure tendency, cloud type, precipitation and temperature when either a warm, a cold or an occluded front passes.
- List the areas where most cyclones that influence North America form and what types of air masses are associated with each.
- Comment on the intensity of cyclonic storms during the spring and explain why they can be so strong.
- Outline and describe the stages in the development of a thunderstorm.
- Describe the formation of a roll cloud, supercell and a squall line.
- Summarize the events that lead to lightning and thunder.
- Describe the atmospheric conditions that are most conducive to the formation of tornadoes.
- Describe the path width, length, direction and speed of an average tornado.
- Recognize the Fujita Intensity Scale as a measure of tornado intensity and explain how F-scale ratings are determined.
- Discuss where hurricanes form and what gives them their energy and what they are called in different parts of the world.
- Describe what the profile of a hurricane looks like and its life cycle.
- Understand the Saffir-Simpson scale and what its categories mean.
- Distinguish between warnings and watches for tornadoes and hurricanes.

Unit 5-World Climate and Climate Change

- Describe what is meant by the climate system and list its 5 parts.
- Describe several ways in which past climates are deciphered.
- Discuss possible natural causes of global climate change and how humans have modified the environment over thousands of years.
- Discuss how aerosols get into the atmosphere, their effect and how they are removed.
- List several possible consequences of a greenhouse warming.
- Classify climates with the aid of a Köppen classification key.
- List four common misconceptions about deserts.

Date Completed: 23 March 2012